CHAPTER 7
Treatment Principles and Procedures

- **Lesson Purpose**

  To give the student knowledge of common treatment principles and procedures in the chiropractic setting.

- **Lesson Objective**

  Upon completion the student will:

  - Learn common treatment procedures and techniques
  - Learn common stretching protocols
  - Learn the principles of physiotherapeutic modalities

Cherkin, DC and Mootz, RD gave an accurate accounting of what many in the chiropractic profession have been trying to relate to the public:

"Spinal manipulation and the profession most closely associated with its use, chiropractic, have gained a legitimacy within the United States healthcare system that until very recently seemed unimaginable. In the past several decades, chiropractic has undergone a remarkable transformation. Labeled an "unscientific cult" by organized medicine as little as 20 years ago, chiropractic is now recognized as the principal source of one of the few treatments of low-back pain, spinal manipulation. In the areas of training, practice, and research, chiropractic has emerged from the periphery of the health care system and is playing an increasingly important role in discussions of health care policy."[1]

Adapted from: AHCPR Research Report, U.S. Department of Health and Human Services, 1997.

General Disclaimer

This chapter contains recommendations for the clinical application of many forms of chiropractic treatment. These recommendations are intended for educational and instructional purposes only and do not constitute a standard of care for any specific clinical situation. These recommendations, which may need to be updated, are intended to be flexible. The recommendations and directives within this text should be considered as basic and not comprehensive. One must always refer to state and federal guidelines to assure legal compliance when educating or applying various treatments and modalities as a chiropractic therapy assistant. The type of treatments and their applications utilized are dynamic, and subject to change readily over time.The recommendations herein would apply to all patients at all places where services are rendered. Treatment guidelines are consistent and universal, regardless of locale, technique, philosophy, method of reimbursement, or liability coverage status. These guidelines are intended to provide a common framework for patient treatment that allows for a more consistent application and improved communication both within and outside the provider's practice. It is not intended to adequately train the chiropractic assistant in all areas of skills necessary to administer physical modalities in a chiropractic office. It is the responsibility of the doctor of chiropractic to ensure proper education, training, and skill development for any persons operating under his or her direction. It is not intended to review every instrument or therapeutic device that may be used in a chiropractic office by the doctor or assistants. It is the responsibility of the doctor to ensure proper training and supervision for the use of all modalities.

Introduction

From the origin of chiropractic care, there have been many forms of treatment given to the chiropractic patient with varying effects and many are based on evidence-based research and empirical evidence. The initial time-tested use of the chiropractic treatment has been to correct the vertebral subluxation and help restore normal neural communication between brain and body.[11] Treatments have been adapted throughout the years to include treatment ranging from numerous musculoskeletal ailments (whole body) to somato-visceral ailments. Colloca, DC states that, "…chiropractic spinal analysis has developed to focus on the structural and functional relationships of the human frame as a basis

of locating areas of dysfunction, termed subluxation, while hypotheses have been submitted to account for purported findings."[54] Although many early claims were empirically based and anecdotal, within the last 40 years members of the chiropractic profession have increasingly participated in the scientific method, utilizing proper research protocols to attempt to substantiate these claims. Concurrently, knowledge gained from biomedical literature and other health-related disciplines has helped the process of dissemination of information to support several theories now reflected in chiropractic texts.[54] Chiropractic colleges and universities are continually producing more and more graduates and this supply has increased the demand for higher quality research. The profession has met this challenge and continues to submit high quality papers to reputable journals and has developed numerous research centers in our colleges and universities.

As disease care has increased, improved diagnostics and increasingly specialized forms of healthcare providers in the medical, osteopathic, physical therapy, psychology and complementary health fields have increased. There has been an increased incidence of patient dissatisfaction due to patients falling through "cracks" in the healthcare system. To counter this, the chiropractic profession has continually studied all the professions to identify treatment that will aid the chiropractic adjustment and therefore honor the patient by giving them the best treatments at our disposal. There has been an increasing trend of combining specialties in the healthcare paradigm, which was almost unheard of 20 years ago. The increased demand of high quality care has caused a shift in the thought process of individualistic care.

This chapter focuses on the specifics of the chiropractic theory and its main forms of treatment; adjustments/manipulation, manual therapy, soft tissue therapy, and physiotherapy. It will also teach you how to use their combined effects to treat dysfunction and injury.

The following section is an account of treatment philosophies that are accepted by some, but not all. As with any advancing healthcare discipline, there are differing treatment and philosophical views within that discipline. The intent of this section is to inform you of the variety of views within the chiropractic profession and show that patient care and clinical outcome supercedes any conflicting views.

Throughout history, manipulation has been a treatment technique to improve back pain. It is commonly accepted that an English medical doctor named Galen found evidence of spinal manipulation as treatment

for pain while Egyptians were building the pyramids. Manuscripts have been found signifying the use of joint manipulation within ancient Eastern medicine as well. As we entered the 20th century, Gatterman, DC references the founder of chiropractic, Daniel David Palmer, as concluding after much study, that disease was due to interference with the nervous system, primarily at the site where the spinal nerves exit the spinal foramen.[11, 12] He attributed this interference to approximation of the vertebrae, which he termed subluxation.[12] Chiropractic maintains that the nervous system plays a large role in governing the systems in the body and that it is responsible for maintaining homeostasis within the body. Health is seen by chiropractors as a continuously active homeostatic process that maintains a disease-free state.[11] The nervous system and the endocrine system share an important role in maintaining equilibrium throughout the body.[11] Hans Selye spoke of homeostasis as "the body's tendency to maintain a steady state, despite external changes; coined *physiologic stability*."[11, 13] Chiropractic philosophy is based on the concept of our own body's innate ability (innate intelligence) to heal itself. The philosophy is based on the premise of the continual attempt of the body to restore itself to normal or "ponos," and the healing force of nature, which cures from within or "vis medicatrix naturae."[11]

Understanding Subluxation

D.D. Palmer founded a profession in 1895 on the premise of correcting subluxations, which has grown and multiplied to allow thousands of chiropractors to deliver quality healthcare to the public. The term "subluxation" in medicine typically refers to an incomplete dislocation or an operable spinal lesion that is considered unstable.[14] This definition appears to be used primarily by orthopedics for mechanical lesions. Chiropractic coins "subluxation" in more of a *complex*, such as the VSC or Vertebral Subluxation Complex, whereby a "mechanism of dis-relationship of vertebral segments and other articulations may result in widespread functional derangement as well as disease of various tissues."[11,15] There are 5 parts to this complex, namely spinal kinesiopathology, neuropathophysiology, myopathology, histopathology, and pathology (See Figure 7.a).

Figure 7.a

Components of Vertebral Subluxation Complex

Kinesiopathology – Abnormal motion of the spine occurs, yielding a sprain to the small joints of the spine. When the tissue heals, sometimes it heals incorrectly causing it to be hyper-mobile or hypo-mobile.[11, 14]

Neuropathophysiology – When the joint and its surrounding tissue heal poorly, the adjacent nerve complex can be aggravated interfering with proper impulses from brain to body.[11, 14]

Myopathology – Once the nerves are aggravated, the spinal muscles can become weakened or can spasm. At this point, adhesions can develop. This functional abnormality will cause faulty muscle movement patterns that can create a faulty biomechanical movement cycle within the body.[11, 14]

Histopathology – When tissue undergoes prolonged injury, there is inflammation. Adhesions and reorganization of muscular, fascial, and ligamentous cells cause the motor unit stabilizers (muscles and ligaments) to breakdown.[11, 14]

Pathology – When disease and dysfunction begin within and around the spinal joints.[11, 14]

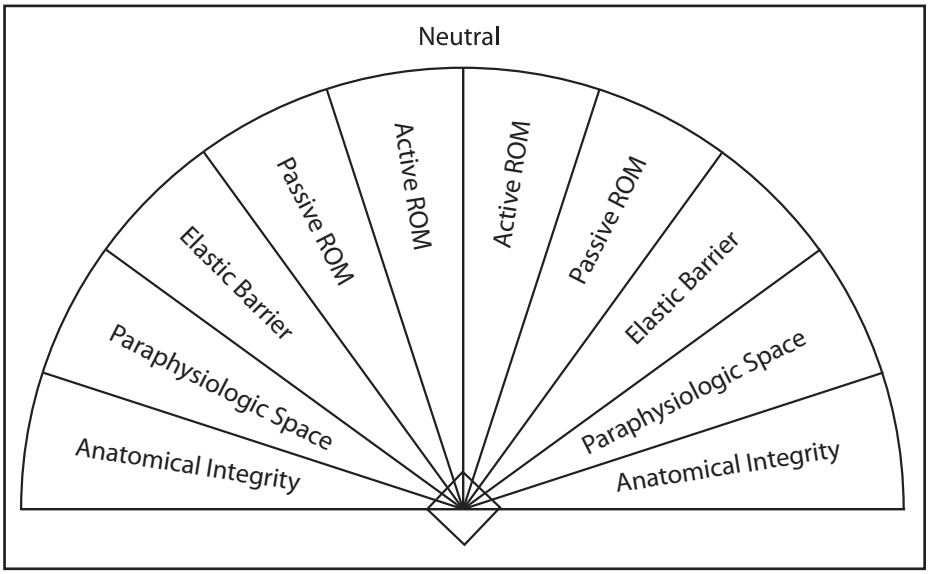
A growing segment of chiropractic prefers to use the term *functional spinal lesion* to describe subluxation. This segment tends to place more of an emphasis on biomechanical and neuromuscular correction, thereby focusing their efforts on restoring spinal function through manipulation, soft tissue therapy, and exercise rehabilitation. In the chiropractic profession, there is the benefit of multiple view points and research facilities which continue to identify ways to improve spinal function and improve patient healing through persistent advancements.

The chiropractic adjustment can correct this complex, and its healing effect is amplified with the addition of various other soft tissue and joint treatments. Gatterman points out that many forms of manual therapy can be employed and, at times, there are treatments more appropriate in dealing with spinal disorders.[11]

Manipulation vs. Mobilization

There are many within the healthcare community that use manipulation and mobilization interchangeably; however, there is a definite distinction in terms and applications. The synovial joint within the spine is where the distinction occurs. To understand this point more clearly, look at Figure 7.b. There is a normal range of motion within a diathrodial joint where active muscular motion occurs without resistance.[11] Just outside this normal motion, there is a small range of passive motion that is not controlled by voluntary muscles.[11] At this point, motion can be given by springing or tractioning the joint; characterizing mobilization. After this passive range of motion, there is an "elastic barrier of resistance" that leads into the paraphysiological space whereby the audible or cavitation occurs and the space where manipulation is performed. Once this space is passed, the anatomic limit of integrity is reached where tissue tearing can occur.[11]

Figure 7.b: Diathrodial Joint Ranges of Motion Comparison



Manipulation is characterized by forcing the joint beyond the "elastic barrier of resistance" producing a "cracking noise" or "cavitation."[11] The noise heard when an adjustment or manipulation occurs and joint surfaces move apart, resulting in a sudden diffusion of the dissolved gases from within the joint.[16] Of note, manipulation does not have to have a cavitation to be successful. The chiropractic adjustment (manipulation) utilizes short levers to which a high-velocity thrust of controlled amplitude is directed, with the aim of restoring mobility to individual articulations or joints.[11] **Mobilization** takes

place in the passive range of motion utilizing slow stretching motions to help restore normal motion to the joint and is indicated within joints where manipulation is contraindicated or would not be effective.

> ***To summarize:*** **Mobilization** is a slower or low-velocity technique in which the joint remains within its passive range of movement. The treatment can be monitored and resisted by the patient, who has final control. **Manipulation** is a faster or high-velocity, light/low amplitude force technique that takes the joint beyond the passive range, "elastic barrier of resistance," into the para-physiological space. The patient does not have control.

In 2003, the American Chiropractic Association released a compilation of statistics in which manipulation techniques are used throughout the chiropractic profession.[2] (See Figure 7.c.) Descriptions of common techniques are listed below. Chiropractic has many manipulation techniques within its arsenal and those listed below are only a portion of the total; however, they are most commonly used when the profession is reviewed. These manipulation techniques are not inclusive of soft tissue care.

Figure 7.c

Percentage of techniques used by chiropractors

- Diversified 95.9%
- Extremity Manipulating/Adjusting 95.5%
- Activator Methods 62.8%
- Gonstead 58.5%
- Cox Flexion/Distraction 58.0%
- Thompson 55.9%
- Sacro Occipital Technique [SOT] 41.3%
- Applied Kinesiology 43.2%
- NIMMO/Receptor Tonus 40.0%
- Cranial 37.3%
- Manipulative/Adjustive Instruments 34.5%
- Palmer Upper Cervical (Hole in One [HIO]) 28.8%
- Logan Basic 28.7%
- Meric 19.9%
- Pierce-Stillwagon 17.1%

Adapted from: American Chiropractic Association, Claim Solutions Work Group Working Together to Gain Knowledge, 2003 Claims Adjuster Index (CAI)[2]

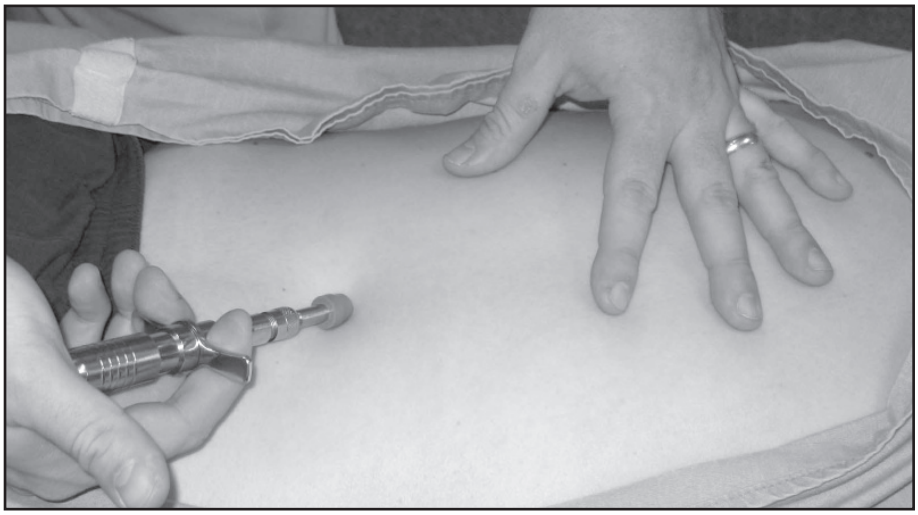
Diversified Technique – This is a widely used type of chiropractic manipulation/adjustment that includes most of the procedures taught at chiropractic schools. This technique is the most commonly used of all chiropractic techniques and is the one probably most familiar to patients. The diversified manipulation/adjustment entails a high-velocity, low-amplitude thrust that usually results in a cavitation of a joint. As the name implies, the Diversified Technique can be used to treat many of the joints in the body.[2]

Diversified Prone Adjustment

Extremity Manipulation/Adjusting – This is the application of a chiropractic manipulation/adjustment to joints other than those of the spine; i.e. shoulder, elbow, wrist/hand/finger, hip, knee, ankle/foot/toe. Examples of conditions treated by extremity manipulation/adjustment include: carpal tunnel syndrome, joint adhesions, gait, or posture-related problems. [2]

Extremity Wrist Adjustment

Activator Method – This is a manipulation/adjustment protocol that is accomplished by using a hand-held, spring-loaded instrument. Instead of the manipulating/adjusting forces being delivered by hand, force is generated with the small device that delivers a faster and lighter thrust than can be delivered by hand. Activator can be used as a primary treatment protocol for all patients, or a selective method for patients who may not desire manual manipulation/adjustment or where manual manipulation/adjustment may be contraindicated. [2]



Activator Adjustment

Gonstead Technique – This is a specific chiropractic technique and is a variation of the Diversified Technique that utilizes manipulation/adjustment by hand that usually results in joint cavitation. X-ray analysis, palpation, and temperature gradient studies may be used in clinical decision-making.[2]

Cox Flexion/Distraction – This is a specific chiropractic technique that uses mechanical and hands-on manipulation/adjustment and utilizes a special table where the spine is tractioned and flexed forward. This technique is primarily used to treat cervical and lumbar disc herniations, non-disc spinal disorders, and to increase mobility of spinal joints.[2]

Thompson Technique – This is a specific chiropractic method and is a variation of the Diversified Technique that uses a special table with several segments called drop pieces. These segments can be raised up a fraction of an inch, so when the thrust is delivered, the table will drop accordingly. The drop pieces assist the thrust while minimizing the force

used for the manipulation/adjustment. Cavitation of the joint may or may not occur.[2]

Sacro-Occipital Technique (SOT) – This is a specific chiropractic technique that uses triangular-shaped blocks, usually placed under the pelvis of the prone patient to treat problems identified in the low back. Low force, slow pressure types of manipulations/adjustments may be used to address joint problems identified in the skull. SOT may be used as an exclusive treatment technique or as an adjunct method of patient management.[2]

Sacro-Occipital Technique

Applied Kinesiology – This is an approach to chiropractic treatment in which several specific procedures may be combined. Diversified manipulative/adjusting techniques may be used with nutritional interventions, together with light massage of various points (referred to as neurolymphatic and neurovascular points). Clinical decision-making is often based on testing and evaluating muscle strength.[2]

NIMMO/Receptor Tonus – This is a specific chiropractic technique based on the presumption that muscles are responsible for causing abnormal joint function. NIMMO addresses muscular problems, usually called trigger points, by applying pressure on the point(s) for variable

Nimmo Technique

amounts of time (usually a few seconds) thus allowing the muscle to relax and acquire its normal length. This procedure allows the bone(s) to which the muscle(s) attach to move normally to restore proper joint function.[2]

Cranial Technique – This is not one specific chiropractic technique, but possibly several techniques using the application of chiropractic manipulation/adjustment to joints of the skull (similar to the SOT technique previously mentioned). Since individual anatomy of skull joints is different, the styles of manipulation/adjustment are different and no cavitations occur.[2]

Manipulative/Adjustive Instruments – These are techniques that include the use of instruments, other than an Activator, to deliver a manipulation/adjustment to the patient. Many of these procedures are used specifically in the upper cervical region, but not all. Precision of the direction of the thrust is claimed to be the advantage of these techniques.[2]

Palmer Upper Cervical (H.I.O.) – This is a specific chiropractic technique used only to manipulate/adjust joint dysfunctions in the upper cervical spine. The theory is that treatment of this area may also address problems throughout the entire body of the patient. Usually no cavitations occur. X-ray analysis is commonly used for making clinical decisions. [2]

Logan Basic Technique – This is a specific chiropractic technique in which light pressure is applied to the ligamentous structures associated with the sacrum and pelvis. Light force is concurrently applied to various spinal levels to reduce pain/symptoms and restore muscle balance.[2]

Logan Basic Technique

Meric System – This is not a specific chiropractic technique, but refers more to clinical decision-making regarding what spinal levels to manipulate/adjust. Spinal segments are manipulated/adjusted (usually with a diversified technique) corresponding to the nerves that supply the area of patient symptoms.[2]

Pierce-Stillwagon Technique – This is a specific chiropractic technique that uses side-posture manipulation/adjustment in the low back and prone manipulation/adjustment in the cervical spine. X-ray analysis is commonly used for making clinical decisions on which spinal level(s) to manipulate/adjust.[2]

Pettibon Systems Adjusting – The Pettibon procedures are an advanced and complete scientific approach to chiropractic that restore harmony, function and biological organization to the body. The Pettibon Chiropractic Adjusting procedures utilize the inherent lever arms of the body to create a mechanical advantage to stimulate the body's righting reflex to cause reduction and stabilization of the Vertebral Subluxation Complex. These procedures are accomplished manually as well as with Pettibon Adjusting instruments. Each patient is instructed in specific in-

office and at-home exercises based upon his/her structural, functional and neurological needs.[3]

Chiropractic BioPhysics (C.B.P.) – Clinical Biomechanics of Posture® a.k.a. Chiropractic Biophysics (CBP®) technique can best be characterized as full spine and pelvis corrective/rehabilitative procedures that have a firm foundation in the sciences of biomechanics and physics. CBP® technique integrates Drop Table, Diversified, Toggle, and Instrument-assisted postural MIRROR IMAGE® adjusting, postural MIRROR IMAGE® exercises and postural MIRROR IMAGE® traction to correct subluxations by restoring normal spinal mechanics.[4]

Toggle Recoil Technique – This manipulation is performed with a sudden shallow thrust (toggle), followed by quick withdrawal (recoil) of the chiropractor's hands while the patient is relaxed.

Blair Upper Cervical Technique – The Blair technique takes into account the natural asymmetries in the body and tailors the adjustment to the specific shape of the area being treated, with a clinical objective of achieving maximum patency of the cervical neural canal. Dermothermographic and functional leg-length analysis are used as diagnostic measures. The Blair adjustment combines a toggle thrust with a 180-degree torque, but no recoil. The patient is side-postured on a table with a drop headpiece.[6]

Direct Non-force Technique (D.N.F.T.) – This is a method of making a chiropractic analysis by skin reflexes and a thumb contact adjustment thrust a little deeper than skin deep. The "D" in D.N.F.T. stands for Directional because of thrusting in a specific direction as determined by analysis. The term, "Non-force" is used because it is non-force compared to some chiropractic techniques. It does not cause the usual cavitations of many chiropractic adjustments. There is also a certain amount of visualization in D.N.F.T.[5]

Bio Energetic Synchronization Technique (B.E.S.T.) – B.E.S.T. is a physical, yet non-forceful, energy-balancing procedure used by the hands to reestablish the full healing potential of the body using its natural healing abilities. B.E.S.T. removes interference and/or distractions that are demanding the attention of the healing power, thereby causing the imbalance in the autonomic nervous system and ultimately leading to disease.[7]

Side-Lying Toggle Adjustment

Atlas Orthogonal Technique (A.O.T.) – Atlas Orthogonal Chiropractic Technique is a branch of upper cervical specific chiropractic, a branch of the healing arts which focuses on the spine's influence on overall health. It utilizes very minute, but supremely focused forces to correct spinal and neck imbalances.

Therapeutic Massage

Many chiropractors are licensed massage therapists or have certifications in various forms of therapeutic massage. An increasing number of chiropractic offices utilize contracted licensed massage therapists to aid in the healing and completion of full recovery of the patient.

Fritz defines therapeutic massage as *"a scientific art and system of assessment, and systemic, manual application of a technique to the superficial soft tissue of the skin, muscles, tendons, ligaments, and fascia, as well as to the structures that lie within the superficial tissue, by means of the hand, foot, knee, arm, elbow, and forearm. The manual technique involves systematic application of touch, stroking (effleurage), friction, vibration, percussion, kneading (petrissage), stretching, compression, or passive and active joint movements within the normal physiologic range of motion.* She continues to state that, *"adjunctive external applications of water, heat, and cold are used for the purposes of establishing and maintaining good physical condition and health by normalizing and improving muscle tone, promoting relaxation, stimulating circulation, and producing therapeutic effects on the respiratory and nervous systems and the subtle interactions among all body systems."*[17]

The practice of massage therapy coincides well with the chiropractor's goal of correcting the cause of the injury or disease. Its approach should be evaluated for what is best for the patient and should not be performed unless the practitioner or therapist has been properly trained. Indications and contraindications can be found in Figure 7.d.

Treatment Tip: Trigger points often refer pain to other areas of the body. Becoming familiar with trigger point patterns help the therapist pinpoint locations where the treatment will be most beneficial.

Trigger Point Therapy Technique

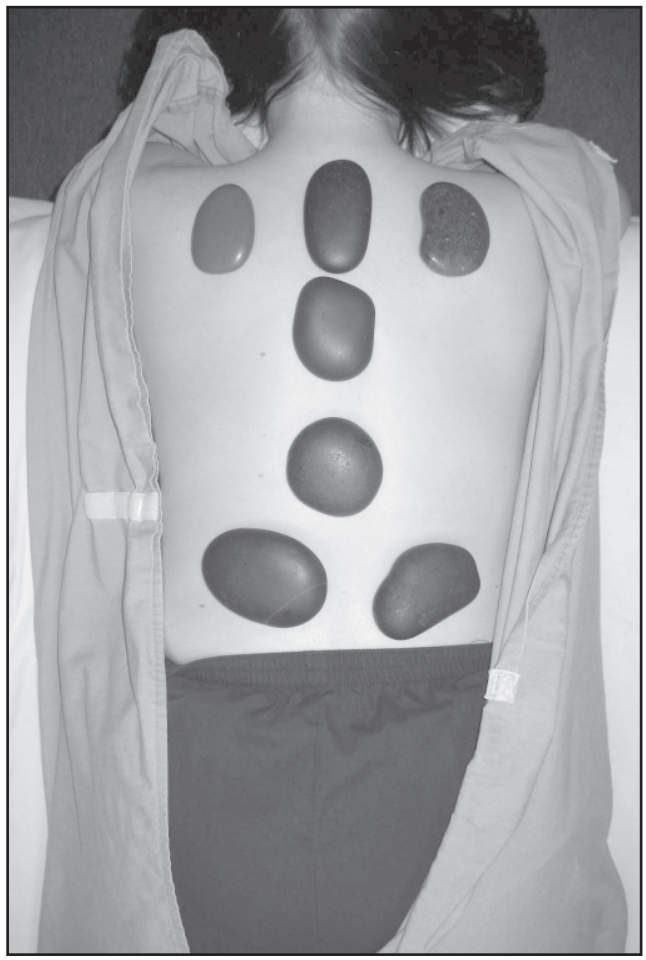
Deep Tissue Massage

Figure 7.d

Indications and Contraindications to Therapeutic Massage[17]

Indications	Contraindications
Back pain	Acutely inflamed joints/soft tissue
Muscle spasm	Suspicion of local malignancy
Orthopedic condition	Phlebitis
Rheumatic conditions	Lymphagitis
Nerve injuries	Acute burns
Neurologic disorders	Acute Dermatitis
Nervous tension/stress	Osteomyelitis
Headaches	Tuberculous lesions of bones
Trigger points	Intra-abdominal organic disease
Radiculitis	Infectious disease
Joint stiffness	Advanced arteriosclerosis
Reduce post-traumatic edema	Suspicion of Hematoma
	Vertigo
	Persistent swelling, pain, or stiffness after a massage

Ashiatsu Oriental Bar Therapy



Hot Stone Massage

Figure 7.e

Multiple Forms of Manual/Bodywork Therapy (Not all-inclusive) [17]

Integrated Approaches

Sports massage	Infant massage	Equine massage
Seated massage	Prenatal massage	Geriatric massage
Russian massage	Hot Stone massage	

Applied Kinesiology

Touch For Health	Applied Physiology	Educational Kinesiology
Three-in-one Concepts		

Myofascial Approaches

Craniosacral therapy	Myofascial therapy	Soft tissue mobilization
Deep tissue mobilization	Connective tissue massage	Swedish massage
Passive Release Technique	Active Release Technique	

Energetic Approaches

Polarity	Therapeutic touch	Reiki
Zero-Balancing		

Manual Lymphatic Drainage

Vodder lymphatic drainage

Neuromuscular Approaches

Neuromuscular technique	Muscle energy technique	Strain/counter strain
Orthobionomy	Trager	Myotherapy
PNF	Reflexology	Trigger Point Therapy

Structural Integration Approaches

Bindegewebs massage	Rolfing	Heller work
Looyen	Pfrimmer	Soma
Bowen therapy		

Asian Approaches

Amma	Acupressure	Shiatsu
Ashiatsu Oriental Bar Therapy	Jin shin do	Hoshino
Tui-na	Watsu	Tibetan point holding
Thai Massage		

Adapted and Modified from Fritz, 2nd edition, Mosby's Fundamentals of Therapeutic Massage, Box 2-1, pg 35

Myofascial Stretching

Chiropractic care utilizes many forms of myofascial stretch techniques as an addition to the healing practice. According to Anderson, stretching "relaxes your mind and tunes up your body." Stretching tends to have cumulative effects of reducing muscle tension, improving coordination, increasing range of motion, prevents injury, prepares the musculoskeletal system for activity, develops body awareness, and feels good. [10]

The Stretch Reflex

The muscular system has a checks and balance system called the "Stretch Reflex," meaning when the muscle fibers are overstretched, a neurological reflex occurs sending a signal to the muscle to contract and protect against injury. This concept leads to the idea that stretching too far will tighten the same muscles that are trying to be lengthened. When stretching, eliminate bouncing maneuvers to avoid the stretch reflex. When this rule is not adhered, micro-tears can occur leading to adhesion formation, which could lead to a loss in elasticity.[10] Some of these stretches apply the rule of reciprocal inhibition, which essentially states "when a muscle (agonist) is contracted, its opposing muscle group (antagonist) is inhibited to allow motion of the limb to proceed. In certain stretches, this law is used to lengthen a muscle, thereby improving its flexibility. Below are numerous forms of stretches that can be applied to a patient under the doctor's orders.

- **Ballistic stretching –** This form of stretching uses the momentum of a moving body or a limb in an attempt to force it beyond its normal range of motion. This is stretching, or "warming up," by bouncing into (or out of) a stretched position, using the stretched muscles as a spring which pulls you out of the stretched position (e.g. bouncing down repeatedly to touch your toes). It does not allow your muscles to adjust to, or relax in the stretched position. It may instead cause them to tighten up by repeatedly activating the stretch reflex.[9] This stretch is not typically used in the chiropractic setting. This form of stretch is rarely used in the clinical setting.

- **Dynamic stretching –** This type of stretch, according to *Kurz*, "involves moving parts of your body and gradually increasing reach, speed of movement, or both." Do not confuse dynamic stretching with ballistic stretching. Dynamic stretching consists of controlled

leg and arm swings that take you (gently) to the limits of your range of motion. Ballistic stretches involve trying to force a part of the body *beyond* its range of motion. In dynamic stretches, there are no bounces or "jerky" motions. An example of dynamic stretching would be slow, controlled leg swings, arm swings, or torso twists.[9, 9b] Dynamic stretching can be used to warm-up for an active or aerobic workout.[9]

- **Active stretching –** Also referred to as *static-active stretching*, an active stretch is one where you assume a position and then hold it there with no assistance other than using the strength of your agonist muscles. For example, bringing your leg up high and then holding it there without anything (other than your leg muscles, themselves) to keep the leg in that extended position. The tension of the agonists in an active stretch helps to relax the muscles being stretched (the antagonists) by reciprocal inhibition.[9] Active stretching increases active flexibility and strengthens the agonistic muscles. Many of the movements (or stretches) found in various forms of yoga are active stretches.[9]

- **Passive (or relaxed) stretching –** Also referred to as *relaxed stretching*, and as *static-passive stretching*, a passive stretch is one where you assume a position and hold it with some other part of your body, or with the assistance of a partner or some other apparatus. For example, bringing your leg up high and then holding it there with your hand. The splits are an example of a passive stretch (in this case the floor is the "apparatus" that you use to maintain your extended position).[9]

Passive Hamstring Stretch

- **Isometric stretching –** *Isometric stretching* is a type of static stretching (meaning it does not use motion) which involves the resistance of muscle groups through isometric contractions (tensing) of the stretched muscles. The use of isometric stretching is one of the fastest ways to develop increased static-passive flexibility and is much more effective than either passive stretching or active stretching alone. Isometric stretches also help to develop strength in the tensed muscles (which helps to develop static-active flexibility), and seems to decrease the amount of pain usually associated with stretching. The most common ways to provide the needed resistance for an isometric stretch are to apply resistance manually to one's own limbs, to have a partner apply the resistance, or to use an apparatus such as a wall (or the floor) to provide resistance. An example of manual resistance would be holding onto the ball of your foot to keep it from flexing while you are using the muscles of your calf to try and straighten your instep so that the toes are pointed.[9]

  The proper way to perform an isometric stretch is as follows:

  1. Assume the position of a passive stretch for the desired muscle.[9]
  2. Next, tense the stretched muscle for 7-15 seconds (resisting against some force that will not move, like the floor or a partner).[9]
  3. Finally, relax the muscle for at least 20 seconds.[9]

Treatment Tip:
Remind the patient to BREATHE during stretching. If the patient holds his/her breath, he or she is less likely to relax into the stretch and receive the full benefit of the treatment.

- **PNF stretching – PNF** is an acronym for *proprioceptive neuromuscular facilitation*. It is a technique of combining passive stretching and isometric stretching in order to achieve maximum static flexibility. PNF was initially developed as a method of rehabilitating stroke victims. PNF refers to any of several *post-isometric relaxation* stretching techniques in which a muscle group is passively stretched, then contracts isometrically against resistance while in the stretched position, and then is passively stretched again through the resulting

increased range of motion. PNF stretching usually employs the use of a partner to provide resistance against the isometric contraction and then later to passively take the joint through its increased range of motion. It may be performed, however, without a partner, although it is usually more effective with a partner's assistance.[9] Most PNF stretching techniques employ *isometric agonist contraction/ relaxation* where the stretched muscles are contracted isometrically and then relaxed. The most common PNF stretching techniques are: Contract-Relax, Contract-Relax-Contract, Hold-Relax-Swing.[9]

PNF Stretch of Levator Scapulae

The proper way to perform a PNF stretch:[9]

1. Assume the position of a stretch for the desired muscle.
2. Tense the stretched muscle for 7-15 seconds (resisting against some force that will not move, like the floor or a partner).
3. Relax the muscle for 2-3 seconds.
4. Stretch the muscle to the next taut point and hold for 7-15 seconds.
5. Perform this sequence 3 times. Relax approximately 20 seconds between sequences.

PNF stretching techniques take advantage of the sudden "vulnerability" of the muscle and its increased range of motion by using the period of time immediately following the isometric contraction to train the stretch receptors to get used to this new, increased range of muscle length.[9]

Chiropractic principles focus on the overall function of the locomotor system. This understanding has created a spotlight to rehabilitate the muscles that attach directly to the spine and pelvis or have effect on the function of the appendicular skeleton. By expanding this focus to include stretching techniques of the lower extremity and upper extremities, chiropractic physicians stabilize and strengthen the core muscles of the spine more effectively, thereby improving their performance. In the following pages there are many examples of stretching "setups" that show many of the muscles that attach to the spine or effect its function. Multiple types of stretching techniques can be applied to these setups to improve flexibility with varied results. Consult your supervising physician on his/her preferred method to apply in the clinical setting and for which conditions the various stretches are most helpful.

Caution:
When performed poorly or with the wrong condition, stretches can be very harmful to a patient. These setups are for ***demonstration only*** and are not intended to teach how to perform the stretch, merely to demonstrate typical techniques used within the chiropractic setting. Please refer to a text designed for stretching instruction as well as your supervising physician.

Stretching

Anterior Scalene stretch

Suboccipital Muscle stretch

Levator Scapulae stretch

Stretching

Upper Trapezius stretch

Rhomboid and Posterior Shoulder Capsule stretch (Example 1 – Lying)

Rhomboid and Posterior Shoulder Capsule stretch (Example 2 – Sitting)

Pectoralis Major stretch

Stretching

Pectoralis Minor stretch
(Note: Rolled up towel has been placed lengthwise down the spine to improve the stretch)

Lumbar Spine Erector stretch
(Example 1 – Forearm on knees)

Lumbar Spine Erector stretch
(Example 2 – Isolating sacrum with forearm support)

Stretching

Hamstring stretch

Gastrocnemius stretch

Illiotibial Band (ITB) and
Tensor Fascia Latae (TFL) stretch

Stretching

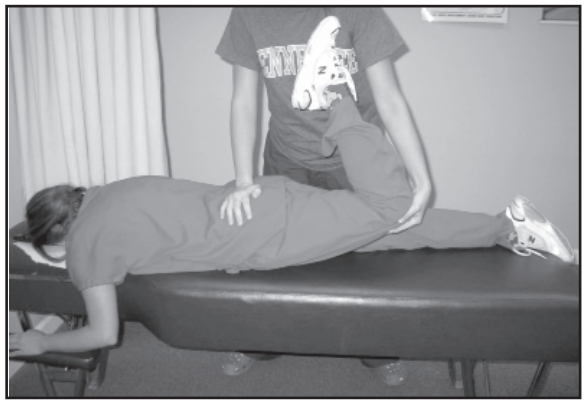
Two-joint Adductor Muscle stretch

One-joint Adductor muscle stretch

Piriformis stretch

Stretching

Illiopsoas Muscle stretch
(Example 1 – Supine)



Illiopsoas Muscle stretch
(Example 2 – Prone)

Illiopsoas Muscle stretch
(Example 3 – Side-Lying)

Stretching

Quadriceps Muscle stretch
(Example 1 – Supine)

Quadriceps Muscle stretch
(Example 2 – Prone)

Quadriceps Muscle stretch
(Example 3 – Side-Lying)

Principles and Procedures of Physiotherapeutic Modalities

Introduction

The most common reason a patient will seek the care of a chiropractic physician, or any other physician, is pain. Pain is a physiological and emotional experience that interferes with normal functioning. One of the most beneficial services a chiropractor or chiropractic assistant can provide is to help alleviate or reduce the amount of pain that a patient is experiencing.

The second most common reason a patient will enter your office is for the correction of a dysfunction. Simply put, dysfunction means that the patient's body is not performing in a normal, healthy manner. This becomes a problem when the patient is unable to carry out his/her normal activities of daily living. Correction of musculoskeletal dysfunction is one of the areas of healthcare in which the chiropractic profession excels.

Although the primary treatment unique to the chiropractic profession is the spinal adjustment, many chiropractic offices also utilize a variety of physical therapeutic modalities. The use of these modalities is to enhance the effects of, and compliment the use of the chiropractic adjustment.

Modalities are used in the chiropractic office as an adjunct to the hands-on adjustment or other treatment administered by the doctor. In most cases, the modality will be applied by the doctor or by an assistant under the direction and supervision of the doctor. Generally, the assistant is not authorized to administer therapy without the direction of the doctor. Refer to individual state laws for direction.

The therapy modality should be selected on the basis of desired effect, safety, and practicality of application. The beneficial effects of many types of modalities overlap. For example, a patient may benefit from application of ultrasound, interferential, high-volt, moist heat, or cold packs. In some cases a combination of therapies will be most beneficial. The choice of modalities to be used is the discretion of the doctor. Different doctors may treat the same condition differently. This situation is where the doctor's training and specific experience with a condition leads to multiple ways to treat a particular condition.

A primary importance in the application of all therapies, is patient safety. Although the contraindications for most forms of physical therapy modalities are few, they are important. Also important, is learning how to apply the modalities safely.

This manual is designed to present generally agreed-upon practices relating to the use of the modalities commonly used in chiropractic offices. It is expected that there may be situations in which your individual doctor may have reason to direct you to use or apply selected modalities in a manner different from that presented here. If there are questions or conflicts between the material presented in this overview and the policies of your office, the treating doctor of chiropractic should be consulted.

A wide array of references were consulted in preparation for this manual. Although there are generally agreed-upon principles and practices concerning the selection and application of therapeutic physical modalities, there are also areas of varying opinions. Many uses of these modalities have been common for many years, and are generally thought to be safe and effective, but have not been subjected to rigorous scientific study. The selection and application of any therapy, including those reviewed here, is always best determined by sound clinical judgment by a qualified, licensed clinician.

It is paramount to place emphasis at the cellular level and its response to injury when first understanding the process and application of modalities. The body's innate ability to heal is often facilitated by creating an environment to heal. For example, when a smoker develops bronchitis, it is important to remove the aggravating substance so the surrounding environment or lung tissue in this case has a chance to heal optimally. With regard to mechanical, electrical, or thermal modalities, practitioners strive to facilitate the body's natural physiologic healing response to provide the body with the best environment possible to repair itself.[18, 20, 53]

Starkey defines an application as being "therapeutic" when an external stress is applied to the body and is conducive to the healing process of the injury in its current state of healing.[18] The key to modality application is timing and when applied at the wrong time, recovery may be stalled or slowed.[18]

Physiologic stress can be identified when a particular chemical, mechanical, or emotional force is placed on the body or at the cellular level. There are negative and positive results of physiologic stress and the body responds accordingly. Starkey states that when stress is placed on a cell, it reacts in one of three ways: *1) it adapts to stress, 2) it is altered but recovers, 3) it dies.*[18]

A researcher in 1900, Hans Selye, coined the principle, **General Adaptation Syndrome (G.A.S.),** which essentially states that the body has a particular mechanism for handling stress.[13] He outlined three stages of stress response:

1) ***Alarm stage*** – This stage is the body's fight-or-flight response to an initial change in the body's natural equilibrium. This is where the body mobilizes its defense forces to combat the aggressor or the stressor. For example, when the body's limbs are chilled, the body will redirect blood to the affected areas.[13,18]

2) ***Resistance stage*** – This is thought to be the lengthiest stage when the body's reactive process slows and the natural adaptive process continues to create equilibrium within the somatic tissue.[13,18]

3) ***Exhaustion stage*** -This is the stage in which the stressors overcome the physiologic response of the body and the body begins to falter, and injury such as overuse or trauma occurs.[13,18]

With regards to acute or chronic musculoskeletal injury, the G.A.S. principle is imperative to understand the body's soft tissues response to being overloaded from a single trauma or event as well as repetitive forces placed on a tissue. When these processes occur, the healing process begins.

The Healing Process

Once the injury occurs, the healing process of the tissue begins. There are three phases in injury repair, and while each phase has a *distinct* role in healing, the phases themselves overlap each other. Therefore they have no exact beginning or end. These three stages correspond with the three R's during treatment (Reduce, Restore, and Rebuild/remodel).

Phase 1: The Inflammatory Response Phase begins as soon as an injury occurs, and as a rule lasts for 2-4 days. The common signs of this stage include inflammation characterized by swelling, redness, point tenderness, and increased temperature. The body's aim here is to isolate the damage and to protect the area from additional harm.[18, 20]

Phase 2: The Repair Phase ensues a few hours after an injury, and can last from two to four weeks. During this phase, the body removes the waste created by the inflammation process and begins to form scar tissue at the injury location. This early gelatinous scar tissue is fairly weak and is layered randomly throughout the injured tissue.[18, 20]

Phase 3: The Remodeling Phase can last for years, depending on the injury. During this phase, the body reorganizes the adhesive tissue into a design or pattern that favors the original tissue and therefore improves the strength of the scar tissue. The new and improved scar tissue is rarely as strong and pliable as the tissue prior to injury.[18, 20]

Many of our healing physiologic processes are impeded by: length of injury or trauma; excess edema or swelling; faulty blood supply; infection; muscle atrophy or weakness; overall deconditioned health; nutrition; and age.

Goals of Modality Use During the Healing Process

During each phase of the healing process, therapeutic modalities are beneficial in helping to encourage proper and efficient healing. When applying a modality, it is important to know what the goal of the treatment is and make sure it corresponds with the current phase of healing.

In the *Inflammatory Response Phase,* the goal of utilizing physiotherapeutic modalities is to reduce swelling and help control pain. A standard principle in the healthcare community is the **R.I.C.E.** principle which should be applied to the injured site once it occurs. The acronym of **R.I.C.E.** stands for **rest, ice, compress,** and **elevate.** Modalities used during this phase include acute frequency settings in or with electrical stimulation, low-power laser, ultrasound, and range of motion exercises. These modalities combined with thermal therapies such as ice or heat are quite effective.

Figure 7.f

The R.I.C.E. Principle

Rest helps to protect the area from further injury and allows the body to focus on healing.

Ice (**Cryotherapy**) helps to reduce swelling and provides an analgesic effect on the injured tissue. *(Using heat during this phase can actually delay the healing process by increasing swelling in the area.)*

Compression and **Elevation** help to decrease swelling.

Electrical Stimulation and **Low-Power Lasers** help to decrease pain.

Ultrasound helps to stimulate cells and encourages healing.

Range of Motion Exercises help with lymphatic draining and can help reduce swelling and stiffness.

During the *Repair Phase*, much of the swelling and inflammation has subsided and the goal is to help the body clean up the injury site and begin to form scar tissue. Common modalities during this phase include heat or ice, compression, various frequencies of electrical stimulation, low-powered laser, and exercises (See Figure 7.f).[53]

Figure 7.g

Repair Phase Modalities

Heat (**Thermotherapy**) is applied in this phase after most of the swelling has subsided. Hydrocollator packs, paraffin, and warm whirlpool help to increase circulation and decrease pain.

Ice (**Cryotherapy**) may still be common in this phase if swelling is persistent or if thermotherapy creates a reoccurrence of inflammation.

Compression can still be used at this stage to help remove toxins and fluid from the area.

Electrical stimulation can be used for pain control, increasing circulation, reducing spasms, and in certain settings create muscle-pumping actions to aid in waste removal.

Low-powered lasers can help decrease trigger points and speed up the healing process.

Range of Motion and **Strengthening** exercises should be progressing in this phase to prevent atrophy and restore mobility.

During the *Remodeling Phase,* the importance is to return to normal activity. Goals include helping to properly align scar tissue and increasing the load capabilities and flexibility of the new tissue, as well as increasing the strength and symmetry of the surrounding musculature. Some common modalities include ultrasound, shortwave and microwave diathermy, electrical stimulation, and progressive exercise rehabilitation.[20]

Figure 7.h

Remodeling Phase Modalities

Ultrasound and **Diathermy** help promote healing by increasing the flow of healthy blood and assisting in waste removal. This treatment is used less frequently in this stage.

Electrical Stimulation can help with pain but is also used for increasing muscle strength and range of motion.

Exercise is vital in this stage to return full range of motion, increase flexibility, and most importantly to help align and strengthen the scar tissue and surrounding tissue by progressing the load capabilities of the injured area.

Pain Control with Modalities

Pain sensations warn us that a tissue is being injured or has already been injured. Pain helps us modulate activity and is reduced when modalities are applied. Pain is activated by various nerve fibers such as nociceptors, that when stimulated cause impulses to be sent to the brain where pain is perceived.[18]

Acute pain control using modalities attempts to restore the body's homeostasis by providing an optimal environment to heal. Once the inflammatory cascade subsides, and the mechanical and chemical stimulation of the nociceptors subsides, pain is usually eliminated. Modalities are also used to trick or mask pain impulses to disrupt the pain process. Chronic pain is much more complicated and less understood. The effectiveness of modalities is more limited in chronic pain. However, there are applications to help increase range of motion, flexibility, blood flow, and increased strengthening of de-conditioned tissues.[18]

Pain Scales

Pain scales are often used to assess the need for various modalities. Pain scales are used to describe a patient's level of pain. Since pain is subjective, the experience of pain is different and pain scales can provide a means for the patient to better describe the pain and label its severity.[18] Pain scales also create a baseline that allow patients and clinicians to see the progress that is being made. There are various kinds of pain scales commonly used that may include:

Visual Analog Scale (VAS) make use of a line that is labeled "No Pain" on one end and "Severe Pain" on the other. Patients mark where they think their pain falls on that line.

Example: (No Pain) 1-------10 (Severe Pain)

Pain charts allow patients to mark where their pain is on a drawing of the body. Many use different symbols or colors to describe types of pain (e.g. burning, tingling, and aching).

Numeric pain scales tell patients to rate their pain on a scale from 1 to 10, with 10 being the worst pain they could imagine. This is basically the same principle as using the VAS, but it does not require a graphical response.

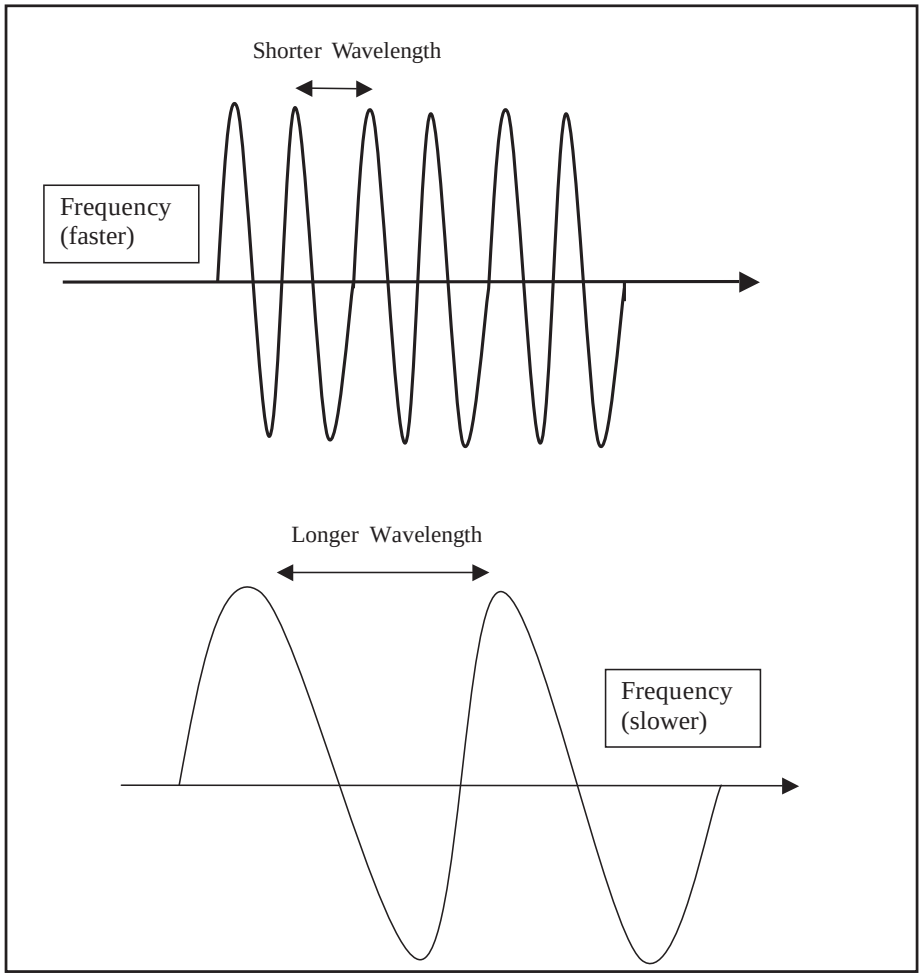
Scientific Principles of Therapeutic Modalities

A large portion of the modalities used in the rehabilitation setting fall into two categories: electromagnetic and acoustic. While these two classes use different forms of energy to create physiological effects on body tissue, both depend on frequency and wavelength to achieve their desired effect.[20, 21]

Frequency is the number of cycles or wave oscillations that occur in 1 second. The unit used to express frequency is Hertz (HZ). One Hertz is the same as one cycle per second.

Wavelength is the distance from one point on a wave to the same point in the following wave.

Figure 7.1



Frequency and Wavelength have an inverse relationship (See Figure 7.1).
- A higher frequency means a shorter wavelength.
- A lower frequency means a longer wavelength.

The frequency and wavelength are determined by radiant energy in electromagnetic modalities and by sound waves in acoustic modalities.

Electrical Stimulation

Electricity Basics

Many of the modalities used in the chiropractic setting require the use of an electrical current passing through the affected tissue to create a desired therapeutic effect on the body. The equipment must modify the current it receives from the outlet and transform it. To understand how the electrical modalities are used on the body, it is important to understand some basics of electricity.

An **electrical current** is the movement of electrons, or negatively charged particles, from a higher potential to a lower potential. The force produced by this movement is called **voltage (V)** and the rate at which the current moves is called an **ampere (A)**. A **watt** is the unit used to measure electrical power. This power is determined by multiplying voltage (force) by amperes (current amount).[53] There are three types of currents used in electrotherapeutic modalities that can produce an effect on tissues.

Direct Current has an uninterrupted flow of electrons from the negative to the positive pole. Direct currents flow in one direction only. An example of direct current is the electricity from a common flashlight battery.[53]

Alternating Current has an uninterrupted flow of electricity that alternates the direction that it moves. The current changes directions when the poles are reversed. An example of alternating current is the electricity from a household wall outlet.[53]

Pulsed Current occurs when the applied current is interrupted intentionally to achieve a specific therapeutic effect. These pulses can be direct or alternating currents. The pulsation can range from very slow to very rapid and this variation is expressed as the *pulse rate*.[53]

Electrical currents can create three types of physiological responses when applied to tissue. These responses are thermal, physiologic, and/or chemical. All tissue rises in temperature when an electrical current passes through it.[18] The higher the resistance of the tissue, the greater the heat response.[18] Electrical currents can also produce a muscle contraction and alter pain impulses at the nerve level. It is also possible that some forms of direct current will affect the tissue chemically.

Alterations in Current Related to Treatment Regimens

When using electrical stimulation, it is important to know the various fact-ors that can influence an electrical current and how these factors can affect the body. By understanding these factors, the parameters of the treatment can be altered to create the desired physiological effect. Below are seven basic points to note when thinking about treatment regimens.

1) One of the first parameters to be determined is whether to use a **monophasic** (direct) or **biphasic** (alternating) current. Biphasic currents are much more efficient at creating muscle contractions. Monophasic currents are considered to be more effective at reducing edema.[20,30]

2) For an electrical current to create a physiological effect on muscle or nerve tissues, it must cause **depolarization**. Depolarization occurs when a chemical, thermal, or mechanical stimulus is strong enough to cause a nerve cell or muscle cell membrane to react or initiate a dicharge of stimuli. This reaction could be an impulse along the nerve or a contraction of muscle fibers. When using electrical stimulation, the current must be strong enough to cause depolarization of the desired tissue.[20, 21]

3) **Impedance** refers to how much a body tissue resists the passage of an electrical current. Electrical currents like to travel through the path of least resistance. In the body, the best conductors are the tissues with the highest water content. Bone, fat, tendons, and

skin are considered poor conductors, while muscle and blood are much more efficient. Nerves are good electrical conductors but are surrounded by fat and fibrous sheaths, which impede flow. Tissues with high impedance mean more current must be used to create depolarization.[18]

4) The **frequency**, or the number of pulses per second, of a current will determine the amount and length of tissue contractions. A higher frequency is used to increase muscle tension since there is very little rest time between pulses. In contrast, a lower frequency can be used as a muscle pump and for edema reduction.[53] (See Figure 7.1.)

5) The **intensity**, or strength, of a current determines the depth the current reaches. The higher the intensity, the deeper the current reaches into the tissue.[18]

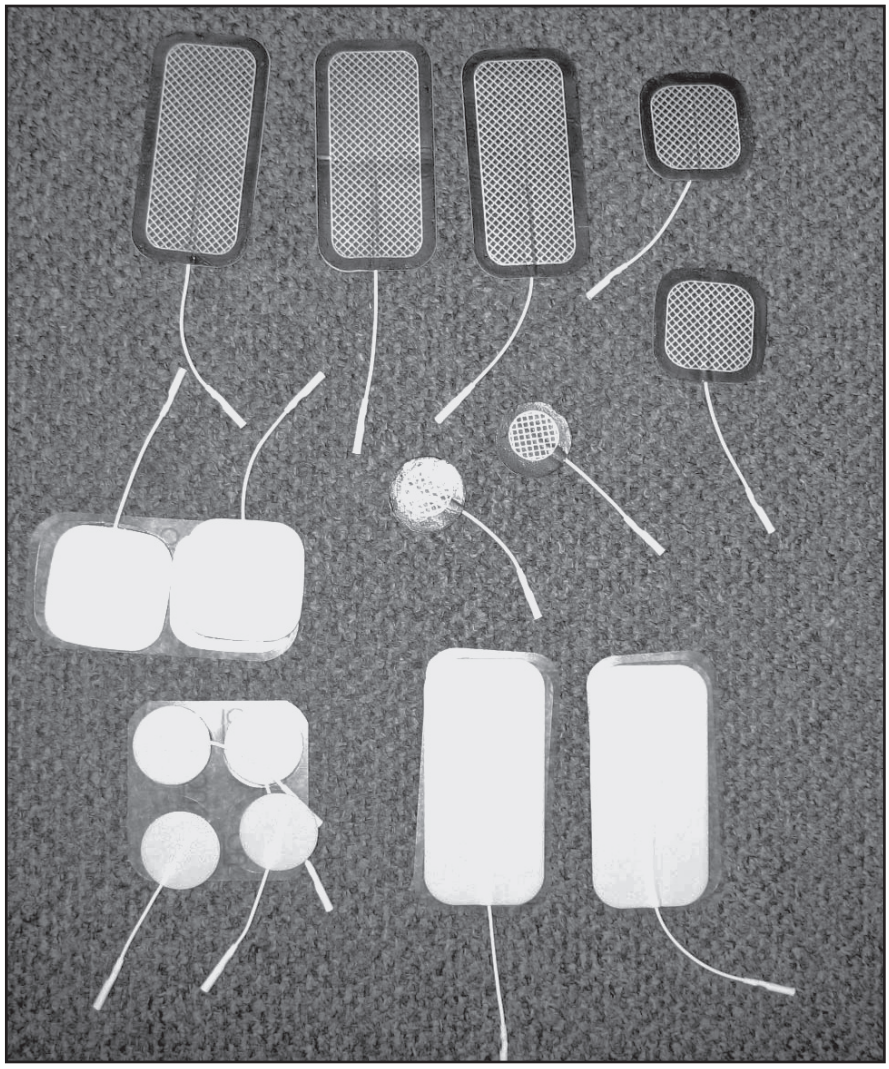
6) The **duration** of a current is the length of time a wavelength lasts. By increasing the duration of a stimulus, more tissue fibers will be recruited and the effects of the current will be spread over a larger area.[18]

7) The **polarity** of a current can determine the effect of electrical stimulation. The polarity can be positive or negative. With biphasic (alternating) currents, the polarity constantly changes and cannotbe altered. However, with monophasic (direct) currents, the polarity can be determined and set according to the desired goal of the treatment. There are several effects of polarity to remember when choosing polarity. Chemical changes might occur, it may change the pH of the tissue, tissue is stimulated, and there is an increased ability to move ions into a damaged tissue. A concept noted in modality use with regards to polarity is **ease of excitation.** This concept describes how efficient polarity is at stimulating a muscle contraction. In general, a negative current flow produces a more comfortable contraction and uses a lower intensity than a positive current flow. The **direction of current flow** is considered important in instances when trying to replicate the normal flow of electrons in the body. The negative electrode is placed distally to the injured site and the positive electrode should be placed proximally.[18, 20]

Clinical Application of Electrical Stimulation

Basic Guidelines for Set-Up

Electrical stimulation is primarily used in the chiropractic setting to create a desired physiological effect on the body. While many modalities used are plugged into an outlet, the fact that they require electricity to operate does not identify them as electrical stimulation. The types considered to be electrical stimulators are those that pass an electrical signal through the body. There are many forms of electrical stimulation including high-volt stimulation, low-volt galvanic, interferential stimulation,



Electrical Stimulation Pads

Russian stimulation, microcurrent, and T.E.N.S. units.[18] Some of the known uses of electrical stimulation are pain control, edema control, muscle re-education, fracture healing, tendon and ligament healing, and wound healing.[20] Before starting a treatment, it is important to identify the goals of the treatment and make sure the type of electrical stimulation and the treatment settings are appropriate. The following are general guidelines for setting up each treatment of electrical stimulation.[18, 45, 46]

1) Check the leads and wires to make sure there are no frayed or damaged wires and that the outlet and wires are properly connected.

2) Clean the area to ensure proper contact with the skin by using an appropriate alcohol based solution.

3) Make sure all controls are in the *off* or *zero* position before applying electrodes.

4) Electrodes must be properly inspected before application. If using rubber electrodes, make sure to apply water, conductive gel or a wet sponge to improve the electrical contact with the patient. If using self-sticking gel electrodes, inspect them for damage or wear. There are certain qualities that electrode pads have that can affect current flow.

   - Electrical current depth increases as electrode spacing increases.
   - Smaller electrodes have a greater current density then larger electrodes.

5) Set the necessary parameters (frequency, mode, duration, etc.) before starting the treatment as determined by the overseeing chiropractic physician.

Caution:
Patients should never feel the sensation of hot pins and needles or major discomfort during electrical stimulation. Many patients have a "no pain, no gain" mentality and believe more stimulation is better. If the treatment is too strong or painful, the patient will not relax for the benefits of the treatment or worse, they could receive a skin burn.

High-volt vs. Low-volt Stimulation

Both high-volt and low-volt stimulators use a direct current that flows in only one direction. In both of these units the desired polarity (positive or negative) must be determined for each treatment. Each type of stimulator has various treatments it is commonly used for. [18, 20]

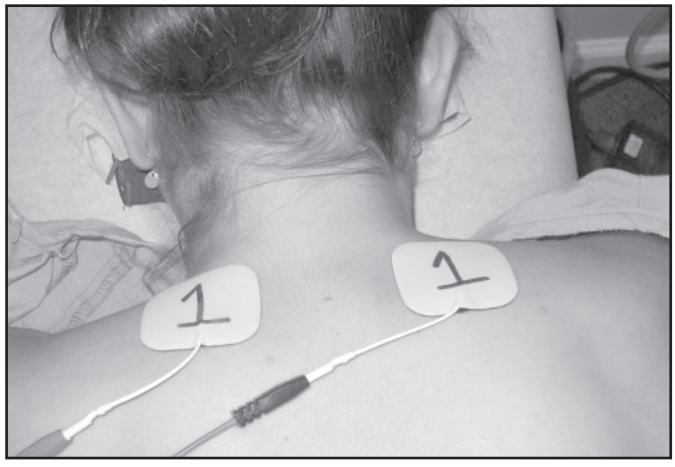
Pulsed high-volt stimulation is commonly used for muscle re-education, nerve stimulation, edema reduction, and pain control.[18, 31]

Pulsed low-voltage stimulation can be used in applications similar to pulsed high-volt stimulation.

Continuous low-voltage stimulation can be very effective in changing the pH of the area under the electrode pads, increasing blood flow, and for transportations. There is a risk with continuous low-voltage stimulation of severe skin complications and even burns. Continuous low-voltage stimulation is most commonly used for iontophoresis.[18, 22, 23]

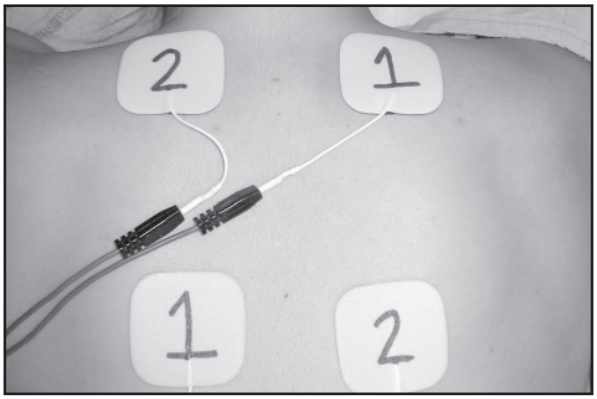
Interferential Stimulation

Interferential stimulation is a widely used form of electrical stimulation that uses alternating currents. It involves the use of two different channels of electrical stimulation that intersect with each other. When the two currents meet, they create a third current that can penetrate tissues with very little resistance. Interferential stimulation is used for pain control, muscle contractions, and edema reduction.[53, 46]



Single Channel Direct Current

When setting up interferential stimulation, the placement of the electrodes is very important. For the treatment to work properly, the two channels must criss-cross over the desired treatment area. The pads should be set up in a square pattern to maximize the interference of the two currents and produce the best results.[18] This pattern is termed quad-polar interferential.



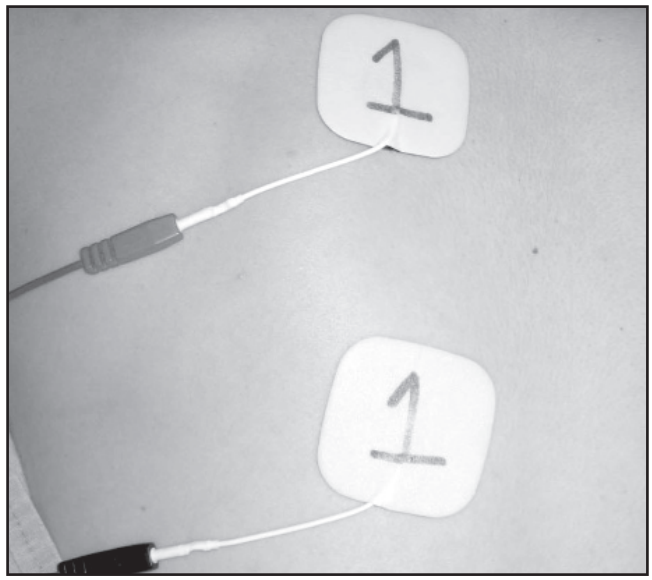
2 Channels Interferential Quad-polar

Treatment Tip:
Altering the vector setting on most interferential stimulation settings rotates the angle of interference and in turn creates a larger treatment area.

Premodulated currents are similar to interferential currents but use only one channel and are often used when four pads cannot be used because of the size or shape of the treatment area. In premodulated stimulation, the desired treatment area should be located between the electrodes. This setup can also be referred to as bipolar. Premodulated current means the interferential current is created within the generator, whereas quad-polar interferential current is formed by criss-crossing the pads.[18, 20] (See Figure 7.j.)

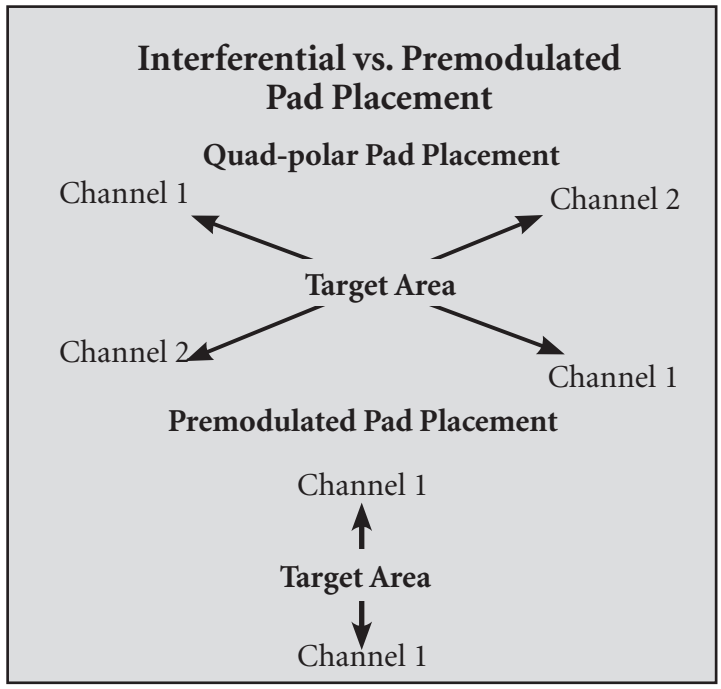
Russian Stimulation, Microcurrent, and T.E.N.S. Units

There are several other forms of electrical stimulation used frequently in the chiropractic rehabilitation setting. Each has unique properties that can be useful in producing certain therapeutic effects in the body.



1 Channel Premodulated Bipolar

Figure 7.j



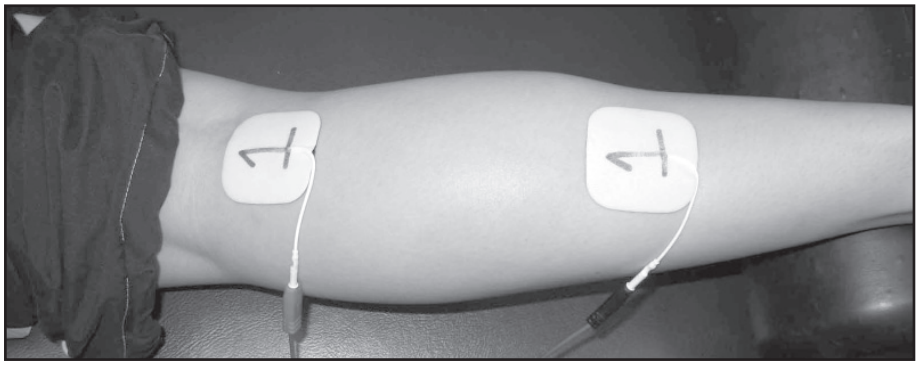
Russian stimulation is an alternating current that is used to create a strong muscle contraction. It can be very effective in muscle reeducation, muscle strengthening, prevention of muscle atrophy, and spasm reduction. Since Russian stimulation forces a muscle contraction, there may be some discomfort with treatment but the intensity should not be intolerable.[18,27,28]

A) For spasm reduction, the contractions should be more frequent in order to create muscle fatigue. For example, a setting of 10 seconds ON, 10 seconds OFF will provide little time for the muscle to relax and may help reduce spasm by creating muscle fatigue.

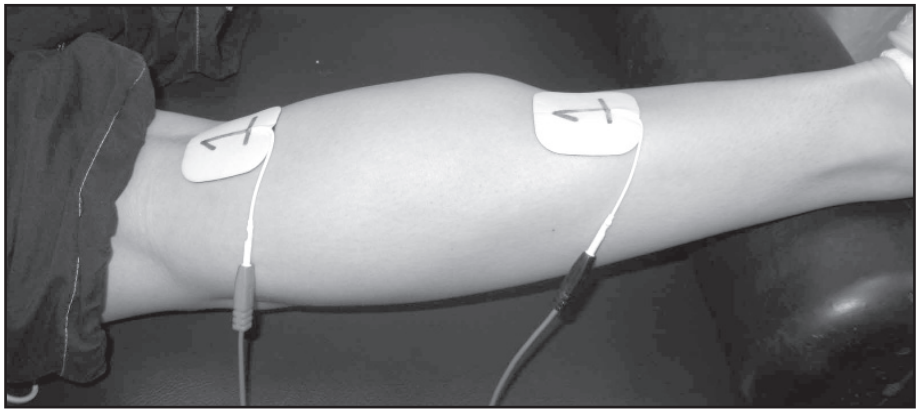
B) For muscle strengthening and reeducation, the contractions should be farther apart. A setting of 10 seconds ON and 50 seconds OFF is commonly used when strengthening is the desired goal.

Treatment Tip:
Russian stimulation can be very effective in reducing the amount of atrophy in muscles that weaken very quickly after injury, such as the Vastus Medialis Obliques (VMO) in the knee.

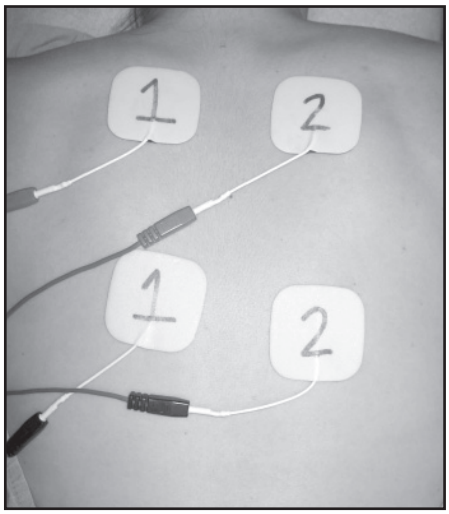
C) During Russian stimulation, typically one channel is used and the electrodes should be placed near both the origin and insertion of the targeted muscle group in order to get the most effective contractions.[20] There are setups labeled *co-contraction* and *reciprocal*; however, the individual machine owner's manual should be consulted for these techniques.



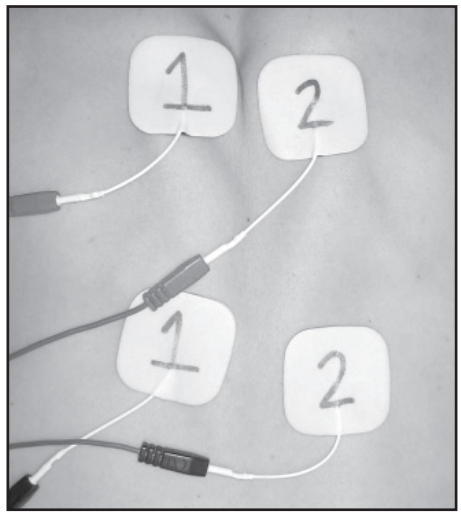
Russian Stimulation relaxed



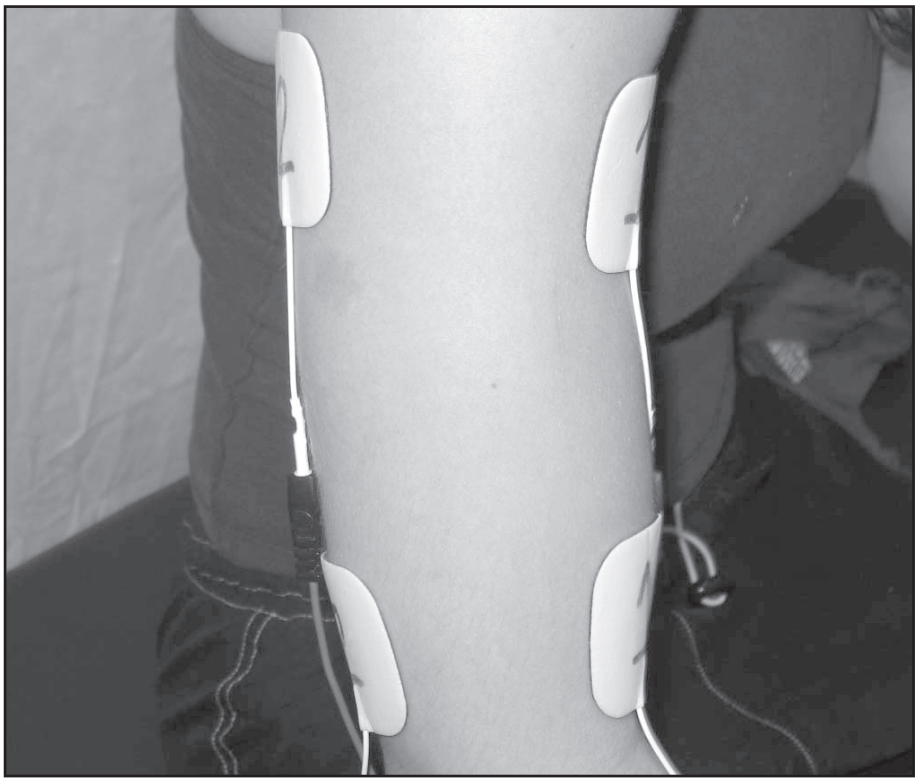
Russian Stimulation contracted



Russian Stimulation
Co-contraction relaxed



Russian Stimulation
Co-contraction contracted



Russian Stimulation Reciprocal setup

Microcurrent Stimulation

Microcurrent stimulation or low intensity stimulation, is often used when the goal is to promote healing. It is used for the stimulation of bone formation in fractures, the acceleration of wound healing, and also to increase the rate of the healing process in injured tissues. The patient often feels no sensation with microcurrent stimulation. The electrode pads should be placed so that the current runs through the injured tissue site.[18, 23]

T.E.N.S. Unit

Transcutaneous Electrical Nerve Stimulation (T.E.N.S.) units are small, battery-powered electrical stimulation devices that may be *carried or worn by the patient*. Like office-based units, the T.E.N.S. units must be operated in a specific manner to be safe and effective. Most T.E.N.S. units have adjustments to vary the frequency, pulse duration, intensity, or other signal characteristics.[18] The prescribing doctor of chiropractic

should determine the proper settings, and the patient should be instructed carefully in how to apply the therapy. Precautions need to be taken to avoid skin irritation and prevent dependency on the unit. Instructions should include proper unit settings, placement of electrodes, and care of unit and electrodes. T.E.N.S. units are primarily used for pain relief only by masking the pain and releasing the body's natural pain mediators; enkephalins and endorphins. The patient should be educated to realize that the primary effect is to reduce pain and this should be differentiated from the other more therapeutic forms of electrical stimulation.[20]

Indications and Contraindications for Electrical Stimulation

There are many indications for the use of electrical stimulation. For each treatment, it is important to determine what the goal of the treatment is and if those goals are consistent with the indications for using the machine as well as the contraindications. Figure 7.k includes a list of indications and contraindications.

Figure 7.k

Indications and Contraindications for Electrical Stimulation [18,20]

Indications for Electrical Stimulation

Acute or chronic pain
Increased circulation
Muscle strengthening
Re-education/prevention of atrophy
Tissue/fracture healing
Muscle spasms

Contraindication for Electrical Stimulation

Cancer
Carotid Sinus abnormalities
Pacemakers
Defibrillators
Near the heart
Trans cerebrally (through the head)
Areas of impaired sensations
(Diabetes, neuropathy)
Open wounds
Directly over metal implants

Iontophoresis vs. Phonophoresis

Iontophoresis and phonophoresis are both used to drive specific medications into a desired tissue. However, while the treatments may sound similar, the method behind their effectiveness is different. **Iontophoresis** is the use of a direct electrical current to drive ions into the body. **Phonophoresis** uses acoustic energy, or sound waves, to drive molecules through the skin into the tissues.[18]

Iontophoresis

Ion Transfer Basics with Iontophoresis

An **ion** is a positively or negatively charged particle. Ions want to move towards the opposite polarity. Therefore, positively charged ions will move towards a negative electrode and negatively charged ions will move towards a positive electrode.[20, 18] Iontophoresis is beneficial because it allows patients to receive topical medications with a certain charge and drives them into the skin by using an electrical current. Once these charged ions are introduced through one electrode they will travel through the body to the opposite electrode. This allows medication to be delivered to site-specific locations in the body. Some uses of these charged medications include decreasing inflammation, reducing pain, healing tendonitis, and encourages wound healing.[18, 20]

Iontophoresis Equipment and Treatment

The use of iontophoresis requires a specific, low-voltage, direct current machine, electrodes capable of holding the medication, and an ionized solution. The machine used should deliver a continuous direct current that maintains a constant voltage output. The key in iontophoresis is that the machine adjusts to the changes in tissue impedance which reduces the risk of burns.[18] Machines called iontophoresors are most commonly used because they adjust their amperage according to the amount of impedance to ensure a constant output. The single most common problem associated with iontophoresis is the possibility of a chemical burn that usually occurs as a result of the direct current itself, and not because of the ion being used in treatment.[20, 53]

- Recommended current amplitudes used for iontophoresis range between 3 and 5 μamp.
- Recommended treatment durations range between 10 and 20 minutes, with 15 minutes being average.
- During this 15 minute treatment, the patient should be comfortable with no reported or visible signs of pain or burning.
- The therapist should check the patient's skin every 3-5 minutes during treatment for signs of skin irritation.
- Since skin impedance usually decreases during the treatment, it may be necessary to decrease current intensity to avoid pain or burning.

The electrode pads most commonly used in iontophoresis have a special area that holds the medication. The electrode that houses the medication is considered to be the **active electrode** and should be placed over the desired tissue.[18] The second electrode is called the **dispersive electrode** and should contain some form of a conductive agent such as water or gel.[18] The lead placed on each electrode is determined by the polarity of the medication.

A) If a solution has a positive ion charge then the positive electrode lead attaches to the active electrode.
B) If a solution has a negative ion charge then the negative electrode lead attaches to the active electrode.

There are many different ion solutions that are commonly used in iontophoresis.[18] Each one has unique characteristics that create certain physiological effects on the target tissue. It is important to know the ion charge and indications for each solution so that the most beneficial treatment is administered with as few side effects as possible.[20] A physician must prescribe most of these medications before they can be used. Two commonly used medications are Dexamethasone and Lidocaine. This treatment should only be used under the direction of a healthcare practitioner licensed to administer medication. This treatment is usually seen in a chiropractic setting where a medical doctor, nurse practitioner, or physician's assistant prescribes the treatment. Defer to the owner's manual for specific medications that could be used.

A) Dexamethasone is a negatively charged solution that is used with conditions including tendonitis, epicondylitis, plantar fasciitis, and other inflammatory conditions.[18]

B) Lidocaine is a positively charged solution that may be used to treat acute inflammation such as bursitis and tendonitis, and may also create an analgesic effect.[18] (As a safety check, be sure to ask about any allergies before administering medication.)

Indications and Contraindications

With all iontophoresis treatments, care must be taken to ensure proper application to avoid skin irritations and possible skin or tissue burns. When used properly, iontophoresis can be an effective way to treat an area without the use of injections or oral medications that have a systemic (versus localized) effect. The patient should feel a tingling and possibly itchy sensation, but should not feel pain, burning, or any other discomfort. There are many indications and contraindications for the use of iontophoresis. Before applying any ion solution, the patient must be questioned about any known reactions to medication (See Figure 7.L).

Phonophoresis

Phonophoresis differs from iontophoresis in that it uses acoustic energy, or sound waves, to drive molecules through the skin into the tissues. Ultrasound opens pathways that allow the medication to be absorbed easily through the skin.[18, 52] The treatment does not have the risk of burns as much as iontophoresis. The advantage of phonophoresis is its noninvasive nature, compared to injections, and it is safer than oral medication because its medication bypasses the liver.[18] The application of phonophoresis is consistent with ultrasound application. Please see the section in this chapter on ultrasound for specific application techniques. See Figure 7.M for a list of indications and contraindications. As with iontophoresis, prior to applying medication solution, the patient must be questioned about any known reactions to medication.

Electromyographic Biofeedback [18, 20]

Biofeedback Basics and Clinical Applications

Biofeedback is gained through the use of an electrical instrument that provides information related to certain actions in the body. There are several kinds of biofeedback frequently used; however, electromyographic biofeedback is most common in the therapeutic rehabilitation

Figure 7.l

Indications and Contraindications for Iontophoresis [18,20]

Indications for Iontophoresis Use

Inflammation from conditions such as: tendonitis, bursitis, epicondylitis, plantar fasciitis

Edema

Scar tissue

Creation of an analgesic effect

Contraindications for Iontophoresis Use

Cancer

Defibrillators

Areas of impaired sensations (Diabetes, neuropathy)

Known allergy to ion being introduced

Infection

Carotid Sinus abnormalities

Near the heart

Open wounds

Skin burns

Areas around eyes, skull, genitals

Pacemakers

Trans cerebrally (across the head)

Directly over metal implants

Skin hypersensitivity

Pregnancy

Figure 7.m

Indications and Contraindications for Phonophoresis [18,20]

Indications for Phonophoresis

Inflammation from conditions such as: tendonitis, bursitis, epicondylitis, plantar fasciitis

Edema

Scar tissue

Creation of an analgesic effect

Contraindications for Phonophoresis

Cancer

Over the thorax with pacemakers

Over thorax with defibrillators

Over a fracture site prior to healing

Over the heart

Directly over metal implants

Carotid Sinus abnormalities

Skin hypersensitivity

Areas around eyes, skull, or genitals

Pregnancy when used over pelvic or lumbar areas

Infection

Open wounds

Areas of impaired sensations (Diabetes, neuropathy)

Areas of deep vein thrombosis

Trans cerebrally (across the head)

Known allergy to ion being introduced

Skin burns

setting. Biofeedback works by measuring an action and providing feedback through either visual or auditory signals that allows the patient to see the performance of the desired tissue and tries to make changes or corrections.[18] The benefit of biofeedback is that performance changes can be seen immediately, creating positive reinforcement and encourages the patient's progress. There are many clinical applications of electromyographic biofeedback.[20]

Muscle reeducation is the most common use of biofeedback in the therapeutic rehabilitation setting. It is used to regain muscle control or to teach a particular muscle or muscle group to contract.[20] It is commonly used in muscles where atrophy has occurred after an injury, such as the Vastus Medialis Oblique (VMO) of the leg after many knee injuries. Along with biofeedback, the patient or therapist should try to facilitate muscle movement by stroking or tapping the desired muscle while looking at the muscle for a reaction.

Relaxation of muscle guarding and the reduction of pain are also helped by biofeedback. The biofeedback equipment can be used to help the patient learn how to relax a muscle that is guarded. This muscle guarding often increases pain so by teaching the muscles to relax, the patient's pain level may be decreased.[20]

Equipment and Treatment Techniques

Electromyographic biofeedback units use the electrical activity created by a muscle contraction to produce a readout of the strength of the muscle contraction. As a contraction increases, the unit will show an increase in the amount of electrical activity. The units use electrodes placed at the target site to pick up this electrical activity. Biofeedback units generally provide either a visual or auditory feedback to represent the amount of electrical activity detected at a muscle site. Visual feedback units typically show electrical activity as a line traveling across a screen, a series of lights, a bar graph, a digital number, or as a meter with a moving needle. Audio feedback units use some form of beeping, clicking, or a tone that decreases and increases as electrical activity changes.[20] (See Figure 7.n for indications and contraindications.)

Figure 7.n

Indications and Contraindications for Electromyographic Biofeedback [18,20]

Indications
Facilitate muscle contractions
Muscle re-education
Decrease spasm and muscle guarding
Promote relaxation

Contraindications
Joint being ill-prepared for excessive tension or range of motion
If muscle contraction may damage skin graft or underlying tissue

Diathermy

Shortwave and Microwave Diathermy

Diathermy is the use of high frequency electromagnetic energy to generate heat in body tissue.[18] The body resists the passage of the electromagnetic energy and this resistance generates heat in the tissues. Diathermy is considered to be a thermal modality because it causes high frequency vibration of molecules in the body that can result in deep heating of targeted tissue sites.[18] There are two kinds of diathermy modalities: shortwave and microwave. Both use a high frequency and shortwave electromagnetic current to create the desired physiological effects. *In general, shortwave diathermy is considered safer than microwave diathermy.*[18]

Shortwave diathermy can be either continuous or pulsed. Continuous shortwave diathermy creates a deep heat while pulsed shortwave diathermy can have thermal and non-thermal effects. There are two methods of application for shortwave diathermy.[18]

1) The *capacitor technique* creates an electromagnetic field by placing the tissue between two electrodes and using the patient as part of the circuit.
2) The *induction technique* creates a magnetic field around the tissue by using either a coil or drum. With the induction technique, the patient is not part of the circuit.

Microwave diathermy units use a higher frequency and shorter wavelength than shortwave diathermy, creating a strong electromagnetic field. Microwave diathermy does not penetrate fat layers very well so it is best used in areas with low adipose tissue such as the hand and foot.[18]

Clinical Applications of Diathermy

There are many various applications of diathermy that have been found to be therapeutic in treating different injuries in the body. These treatments fall into both the thermal and non-thermal aspect of care; however, the thermal uses are more common. Diathermy applications produce many of the same effects as ultrasound treatments but are more efficient in treating a larger target area.[18]

A Some **thermal** uses of diathermy include muscle relaxation, pain reduction, increased circulation, decreased inflammation, and reduced stiffness.

B) The **non-thermal** benefits include wound and tissue healing, and edema reduction.

Indications and Contraindications

When setting up diathermy treatments, it is important to know which method of application is most beneficial in creating the desired physiological effect. Precaution should be taken to keep perspiration from gathering so as to prevent hot spots. Also, metal jewelry and metal implants should not be near the treatment area in order to avoid burns.[20] Therapists who are pregnant should distance themselves from microwave diathermy units because there could be an increased risk of miscarriage. (See Figure 7.0 for indications and contraindications for diathermy.)

Figure 7.0

Indication and Contraindications for Diathermy [18,20]

Indications

Sub-acute and chronic musculoskeletal injuries	Pain reduction	Increased circulation
Muscle relaxation	Improved range of motion	Trigger point reduction
		Wound healing

Contraindications

Areas of reduced sensitivity	Acute musculoskeletal injuries	Near metal, pacemakers
Fluid filled areas or organs	Pregnancy	Malignancies
Intrauterine devices	Ischemic areas	Areas of joint effusion
Near the eyes		

Cryotherapy and Thermotherapy

Cryotherapy

Basics of Heat Transfer

Heat transfer is the movement of thermal energy across a temperature gradient. This transfer is applicable to both heat and cold modalities.[20] Heat travels from warmer areas to cooler areas; therefore, heat transfer works in both directions. When using a heat therapy, the heat from the modality is transferred to the body tissue, making the tissue warmer. When using cold therapy, the heat from the body is transferred to the modality, making the body tissue colder.[20] This heat transfer can create a change in circulation, muscle spasm, and pain. There are three methods of heat transfer: conduction, convection, and radiation.

A) **Conduction** occurs when there is direct contact between the body and a heat or coldsource. Hydrocollator packs, cold packs, ice massage, and paraffin baths are examples of conduction.

B) **Convection** is when air or water particles move across the body and create temperature changes such as a hot or cold whirlpool.

C) **Radiation** is the transfer of heat energy from a warmer source to a cooler source with no physical contact or transference medium being used. Examples include infrared lamps and lasers.

Physiological Injury Response

Cryotherapy is the use of cold modalities to create a decrease in tissue temperatures in the body. This cooling is primarily superficial and is most commonly used in acute and sub-acute injuries. There are many physiological responses of the body when cold therapies are applied. Here are three of the most common responses:

1) One of the greatest benefits of cold therapy is its analgesic effect. It helps to reduce pain sensations by changing the sensation signal that the nerves are conducting.

2) When cold is initially applied to an area, the tissue responds with vasoconstriction. This reduces further inflammation and damage after an injury by slowing blood flow.

3) Cold treatments also decrease cellular metabolism and the accumulation of edema.

Clinical Applications of Cryotherapy

The ability of cryotherapy to reduce edema and pain make it one of the most frequently used modalities for acute injuries. The cold modality methods are typically used for **at least 72 hours** after an injury and most treatments are at least 15 minutes long in order to achieve analgesic effects. With each cold therapy, the body will go through a progression of sensations. Typically there is the sensation of cold, which may be uncomfortable, which is followed by stinging, burning or aching, and then numbness.

Cryotherapy-Contused Muscle

Several forms of cold therapy involve using some form of ice or frozen gel packs applied to the patient. These therapies should be applied until numbness is achieved in order to create the most therapeutic results. With each of these treatments, the patient should be in a comfortable relaxed position and, if possible, the treatment area should be elevated to further reduce swelling. These applications include ice massage, cold hydrocollator or frozen gel packs, and ice bags. *When applying these ice treatments, it is important that the patient never has direct contact with the cold pack.*

Ice Cup used with Ice Massage

Some of the most intense and effective uses of cryotherapy involve immersing the treatment area in cold water and using either a cold whirlpool or an ice bucket.[18] Typically, ice is added into the water until the temperature is 50 to 60 ° F. Cold whirlpools have the added benefit of water flow, which has a massaging and vibrating effect. Contrast baths that alternate hot and cold whirlpools are also beneficial for treatment in sub-acute injuries.

Ice Massage Tip:
To avoid water running everywhere, place a piece of plastic wrap over the ice cup to catch the water. A little lotion on the skin reduces friction.

Home Use Tip:
Patients can create an ice cup at home by freezing water in a paper cup. When it is frozen, rip off the top half of the paper and use the bottom half to hold on to the ice.

There are a few other methods of cryotherapy often used in the therapeutic rehabilitation setting. The Cryo-Cuff combines cold and compression and is beneficial with acute injuries and after surgery.[18] Cold sprays are often used to help reduce muscle spasm by reducing pain and allowing the muscle to be stretched or to relax. Application of cold with electrical stimulation increases the benefits of both applications. See Figure 7.p for a sample form that can be given to the patient for cryotherapy at home.

Home Instruction Tip:

For sub-acute conditions and for patients that are sensitive to extreme cold, a very positive effect can be attained by using gel packs that have been chilled in the refrigerator rather than the freezer. Instruct the patient to use repeated applications of ten minutes on the affected area followed by thirty minutes without the pack to allow the gel pack to re-chill. This can be very helpful for pain control and muscle spasm. This protocol is tolerated better by patients and is more effective than a single application of a frozen gel pack.

Figure 7.p

Sample Patient "Take Home" Instruction Sheet

PROPER USE OF ICE PACKS

- Ice should ALWAYS be used for all new injuries for at least the first 24-72 hours.
- By doing this, your swelling will be reduced which is one of the causes of pain.
- The ice pack should be kept in the freezer and available for any bumps, sprains, or strains.
- The pack will last a long time if you do not bend and crease it.

DIRECTIONS:

- Lay the ice pack directly on the area for 20 minutes—no longer. Remove ice for 1-2 hours (this allows the skin to return to normal temperature) and then repeat at same interval.
- A wet paper towel conducts the ice better.
- If ice-sensitive, use a thin dry towel.

CONTRAINDICATIONS FOR ICE:

- Impaired circulation
- Bleeding in joint (note by discolored and swollen joints.)
- Uncovered open wounds
- Suspected fractures
- Cold allergy or hypersensitivity
- Anesthetized skin

Thermotherapy

Physiological Injury Response

Thermotherapy is the use of superficial heating that is most commonly used in sub-acute and chronic conditions to reduce pain and relax muscle tissues.[18] Heat increases the dilation of blood vessels which improves circulation and encourages the removal of waste at the injury site. Care must be used with heat therapies not to increase swelling and edema.[20] Thermotherapy is usually not used until the sub-acute or chronic stages and after the majority of edema has been reduced.

Clinical Applications of Thermotherapy

As with cryotherapy, many forms of thermotherapy involve applying some form of heat to the affected area. Hydrocollator packs kept at around 170 ° F and wrapped in protective pads apply a moist heat that helps to stimulate the circulatory response.[18] Paraffin baths, where the patient dips the treatment area in melted paraffin, are often used for problems of the hands and feet.[20] Heat application, along with electrical stimulation increases the benefits of both applications. *Never allow direct contact with the patient's skin to the hydrocollator pack; doing so can result in burns.* Warm whirlpools help to reduce muscle spasm, increase range of motion, and have the added benefit of the circulating water which creates a massaging effect. The warm whirlpool should be between 100°-110 ° F. Infrared lamps and fluid therapy units use dry heat to increase tissue temperature and reduce pain.[18] See Figure 7.q for indications and contraindications. See Figure 7.r for a sample form that can be given to the patient for heat therapy at home.

Hydrocollator and Pads

Moist Heat Pack

Figure 7.q

Indications and Contraindications for Heat Therapy [18,20]

Indications

Pain	Sub-acute edema and contusions
Sub-acute sprains and strains	Decreased range of motion
Muscle guarding and spasm	Trigger points
Sub acute and chronic inflammation	

Contraindications

Acute conditions	Peripheralvascular disease
Impaired circulation	Poor thermal regulation
Neuropathy	

Use caution with elderly or frail patients or those with conditions such as diabetes

Figure 7.r

Sample Patient "Take Home" Instruction Sheet

PROPER USE OF HEAT PACKS

- Moist heat packs should be applied only at your chiropractor's instruction because of the adverse effects that can occur. Example: Heat will produce too much swelling into an acute area (i.e. joint), which may feel good initially, but will cause more pain later.

DIRECTIONS:

- Make sure that you use moist heat and **never** dry heat.
- Use about 3-6 layers of towel as a medium between the heat pack and skin. If you have to lie on your back make sure to have additional toweling.
- Use pack for 20 minutes and then remove, 1 hour later repeat procedure.
- Never fall asleep on heat pack.
- Most offices carry moist heat packs. Inquire for information.

Contraindications for Heat:

- Acute conditions
- Impaired circulation
- Neuropathy
- Peripheral vascular disease
- Poor thermal regulation

Caution:
Make sure patients clearly comprehend the instructions regarding use of heat, and repeat them back to you. Often patients are tempted to overuse heat due to its comforting sensation which can increase the inflammatory response. An example statement is: "That heat felt so good, I slept with it on."

Therapeutic Ultrasound

Acoustic Physics and Components of Ultrasound Machines

Ultrasound is the use of acoustic energy at a high frequency that produces both thermal and non-thermal physiological effects. Ultrasound is a commonly used modality that can have both diagnostic and therapeutic effects. In the chiropractic setting, ultrasound is primarily used for its therapeutic effects. [53]

Inside the sound-head of an ultrasound unit is a crystal that converts electrical energy into acoustic energy.[18] Ultrasound is beneficial, due to the manipulation of sound waves that creates vibration of the molecules of the tissue being treated. Most of the waves in an ultrasound are longitudinal. Because of this, they are able to travel through liquids and solids.[53] This means that the energy created by the molecular vibrations of the tissue travels in the same direction as the sound wave. This allows the ultrasound waves to travel deeper into the soft tissue. The depth this sound wave will penetrate is determined by the frequency of the wave.[18, 50] This frequency is measured in megahertz (MHz). In the body, higher frequency waves are absorbed more quickly than lower frequency ones.

There are several different factors that must be determined before performing a therapeutic ultrasound treatment, in order to achieve the desired physiological effects. The parameters must be set to achieve the desired depth of penetration, intensity of treatment, and whether the wave is continuous or pulsed.[53, 50]

A) The **frequency** of an ultrasound application determines the depth the treatment will penetrate. Most ultrasound machines give the option of using a 1 MHz or 3 MHz frequency. The 1 MHz setting

is considered to be a deeper heat and the 3 MHz setting is a more superficial heat.[53]

B) The type of sound wave needed should also be determined before starting an ultrasound treatment. This wave can be either continuous or pulsed. A **continuous ultrasound** treatment means that the ultrasound is always generating energy. This treatment produces thermal effects. A **pulsed ultrasound** setting means that the ultrasound is only producing sound waves for a percentage of the time. This treatment creates mainly non-thermal effects in the tissue that are most commonly used to facilitate soft tissue healing.[53]

C) The **intensity** of the ultrasound is the volume of energy that is being delivered to the area. This is often expressed as watts per square centimeter (W/cm^2). Intensity determines how much heat is produced. The higher the intensity, the more heat the patient should feel. The intensity should always be at a level where a warming sensation is felt but no pain or burning is reported by the patient.[53]

Physiological Effects of Ultrasound

The physiological effects of ultrasound on a treatment area will largely depend on whether the goal of the treatment is thermal or non-thermal.

The thermal effects of ultrasound are typically produced by a continuous wave. The benefits from this treatment are mainly a result of heating the tissue. The common therapeutic effects of continuous ultrasound include: [18]

– Increase of blood flow
– Reduction of stiffness and spasm
– Increase in flexibility of tendon and joint capsules
– Decrease of pain

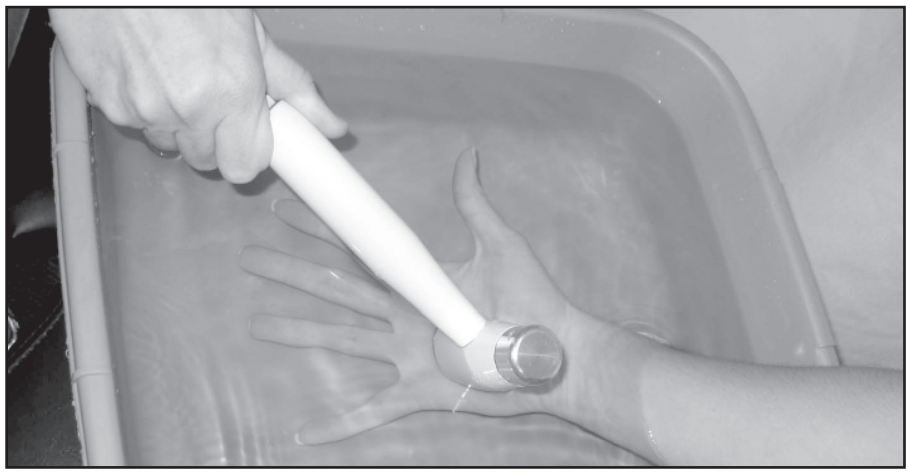
The non-thermal effects of ultrasound are produced by a pulsed wave. There is little heating with pulsed ultrasound waves but the physiological effects are created by the mechanical movement that the pulsed wave creates in the tissue. These effects can include: [18]

– Increased cell permeability to ions beneficial in healing
– Tissue regeneration
– Collagen synthesis
– Increased blood flow
– Reduction of edema

Ultrasound Treatment Techniques

There are some general guidelines that apply when performing an ultrasound. The type of injury and treatment goals will determine the specific parameters of each treatment, but all ultrasound applications have several things in common. Some form of a **coupling agent** must be used in order to ensure the ultrasound energy is transmitted to the patient and is not impeded when passing from the sound head to the patient. The most common forms of coupling agents are water and water-soluble gels.[53]

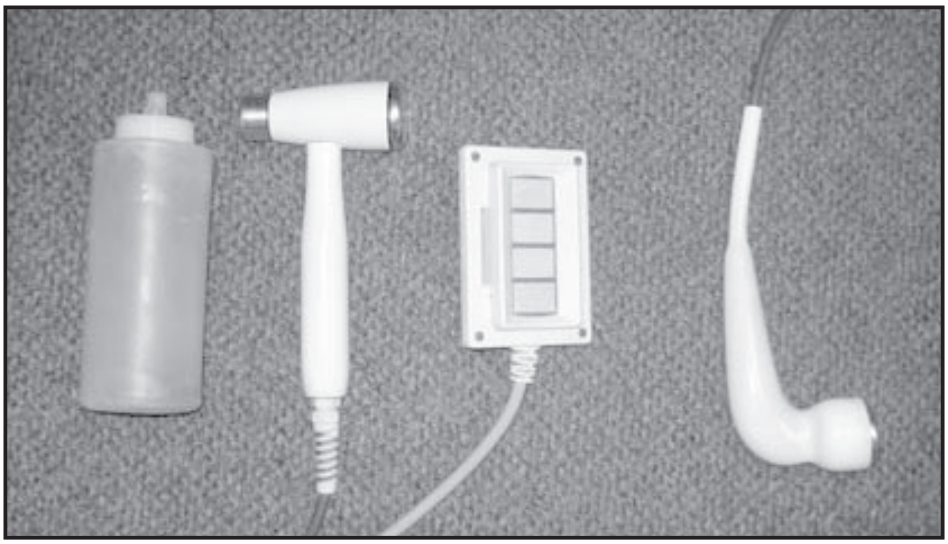
A) Water is used when the area being treated has many bony prominences or uneven surfaces such as the hands and feet. The body part and the ultrasound head should be immersed in a bucket or tub of water and there should be a slight gap between the soundhead and the patient. [20]



Underwater Ultrasound Technique

B) A water-soluble gel is most commonly used for ultrasound treatments. Make sure there is enough gel to allow good contact and lubrication between the sound head and patient. Be careful not to use too much gel, because air pockets can be created. [20]

C) The ultrasound head should be in constant motion in order to prevent hot spots from forming. An overlapping circular motion is most commonly used in order to provide uniform treatment of an area. The treatment area should be around 2 to 3 times larger than the the soundhead diameter for full effectiveness. [18]



Gel and Ultrasound Heads

D) The sound head should remain in contact with the skin at all times. If there is an air gap while the ultrasound is turned on, it could result in damage to the crystal located in the sound-head. When performing underwater ultrasound, there should be a gap between the soundhead and patient but water should always fill this gap. [20]

Ultrasound Treatment

Treatment Tip:

Using a little extra pressure on the soundhead while using gel not only ensures good contact with the skin but allows the wand to act as a massage head.

Precaution:

Avoid using ultrasound over any bony prominence, such as the spinous processes of the spine. There is little soft tissue coverage and this creates a risk of periosteal burns.

Clinical Applications for Therapeutic Ultrasound

Ultrasound is a commonly used modality that can be very effective in treating a wide variety of conditions. The application of ultrasound is used for both its thermal and non-thermal benefits. Following are some of the various clinical uses of ultrasound. (See Figure 7.s for indications and contraindications.)

Use 1) Continuous and pulsed ultrasound can be used to promote **soft-tissue healing** in acute injuries by accelerating the inflammatory response phase. Ultrasound helps to speed up the inflammation process and promote faster healing. During the repair phase of healing, ultrasound helps to increase cell permeability and encourage the body to begin producing scar tissue. [20, 50]

Use 2) Ultrasound can also be used to **increase mobility of scar tissue** that can limit range of motion. Scar tissue is made up of collagen fibers, and the thermal effects of continuous ultrasound works well to increase the flexibility of these collagen fibers. [18]

Use 3) Patients suffering from **chronic inflammation** conditions such as tendonosis and bursitis benefit from ultrasound because it increases blood flow which promotes healing and the reduction of pain. [18]

Use 4) Ultrasound can be used to **assess stress fractures** because of its ability to aggravate the periosteum of the bone. To assess for a stress fracture, use a continuous setting and gradually increase the intensity to 2.0 W/cm^2. If the patient has a feeling of pressure, bruising, or aching during the treatment there may be a stress fracture. *This technique is mentioned for historical purposes; however, it is a technique of questionable reliability and could result in creating a periosteal burn.*

Use 5) Other theorized but unproven clinical applications of ultrasound include absorption of calcium deposits, treatment of plantar warts, and bone healing.

Ultrasound Combined with Other Modalities

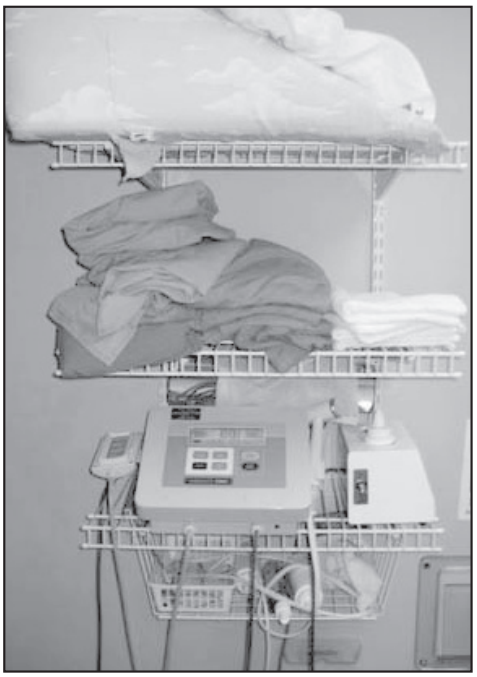
Ultrasound is commonly combined with other therapeutic modalities such as heat, cold, and electrical stimulation. When using ultrasound in combination with other modalities, it is important to know what works well together and what treatments may interfere with each other.

Combo 1) When using an ultrasound unit for thermal effects, a hot pack before the ultrasound treatment may increase the

tissue temperature and decrease the amount of time needed to achieve the desired effects with the ultrasound.

Combo 2) Cold therapy and ultrasound may be used together to try to reduce pain and increase healing in the acute phase of an injury. When using ultrasound and ice, it is most effective to use the non-thermal setting of ultrasound so that the cold of the ice and the heat of the ultrasound do not interfere with one another.

Combo 3) Electrical stimulation and ultrasound are often used in combination with one another. One reason for this is that the beneficial effects of each modality, such as pain reduction and increased blood flow, can be combined into one treatment. Another common use is for the treatment of trigger points. When used together, the soundhead will produce a contraction over trigger points and can help to fatigue the muscle and therefore reduce pain and spasm. [18]



Therapy Bay Setup for Combo Modality

Figure 7.8

Indications and Contraindications for Ultrasound [18,20]

Indications

Acute injuries (pulsed)
Sub-acute or chronic injuries (pulsed or continuous)
Scar tissue
Buristis/tendonitis/tendonosis
Plantar warts

Contraindications

Areas of decreased sensation
Areas of decreased circulation
Growth plates in children
Acute injuries (continuous)
Open wounds or infection
Over the eyes or genitals

Use caution with continuous ultrasound over bony prominences and other areas sensitive to heat.

Light Therapy (Lasers)

Basics of Light Therapy

The term *laser* stands for light amplification of stimulated emissions of radiation. Light energy is made up of particles called photons.[53] The action of these photons is what creates the therapeutic benefits of lasers. There are three main qualities that make laser light different from other forms of light. These qualities are monochromaticity, coherence, and collimation. They allow the laser to focus a very precise, uniform beam at a specific target. [53]

A) **Monochromaticity** is when all the photons have a uniform wavelength and color. [53]

B) **Coherence** is when all the photons have the same wavelength and all of the light waves are in phase with each other.[53]

C) **Collimation** is when there is little divergence of the photons as the light travels through space. This lack of divergence creates a beam of light.[53]

Types of Lasers

There are many variations of lasers that are used for many different purposes including medical, industrial, and military. The kinds of lasers used most commonly in the chiropractic setting are considered to be low-level lasers (cold lasers) that do not produce heat, but instead create photochemical effects in the body. Helium neon and gallium arsenide lasers are the two main kinds of lasers used in low-level laser therapy.[53] The helium neon (HeNe) laser is a gas laser with a continuous wavelength, the effects of which are mainly superficial at between 2-10 mm.[53] The gallium arsenide (GaAs) lasers use a pulsed wave and have effects that reach a depth between 1-5 cm.[53]

Clinical Application of Lasers

The beneficial physiological effects of lasers are believed to occur at the cellular level. Most of the benefits of lasers are thought to come from an acceleration of collagen synthesis, an increase in vascularization, and from its anti-inflammatory interactions. [53] Low-level lasers are most commonly used for wound healing, pain reduction, reducing scar tissue, and edema reduction.

Lasers are very commonly used for wound healing because of their ability to destroy bacteria, increase tensile strength of collagen, and improve circulation at the wound site. This effect helps to shorten healing times and reduce infection.[18] When lasers are used for wound healing, the amount of scar tissue is decreased. The scar tissue that is formed has more tensile strength and more flexibility. Low-level laser therapy helps with pain reduction by altering the nerve impulses.[18] It can be used for both acute and chronic pain. Lasers can be used for treating edema and inflammation because they interrupt the production of chemicals that produce inflammation in the body, such as histamines. (See Figure 7.t for indications and contraindications.)

Figure 7.t

Indications and Contraindications for Light Therapy [18,53]

Indications

Wound healing
Pain reduction
Inflammation reduction
Bone healing
Scar tissue

Contraindications

Cancerous growths
Pregnancy
Application over or into the eyes

Cervical and Lumbar Traction

Introduction

Traction is the application of a longitudinal force applied to the spine and its adjacent structures, to separate the vertebra from each other. These traction forces can be applied by mechanical, manual, or gravitational forces.[18, 20] When combined with active exercise rehabilitation exercises, traction therapy can provide great relief to the patient for a variety of conditions. In this section, we will focus our attention on mechanical distraction techniques.

Traction Principles

Traction's effectiveness is directly related to the body part, the position of the patient, the force, the duration of the traction, and the angle of pull.[18, 19] Starkey states, "to distract a vertebra, the force of the applied traction must be sufficient to overcome the sum of resistance of the weight of the body part being treated, the tension of the surrounding soft tissues, the force of friction between the patient and the table, and the force of gravity."[18] Traction should be applied to hypo-mobile segments only when appropriate. The use of traction on hyper-mobile or loose segments is contraindicated because of the increased chance of tissue tearing, plastic deformation of tissue, dislocation or other potentially permanent undesired sequela. Traction can be applied to the cervical or lumbar spine.

Physiologic Effect of Traction

When traction provides the application of a longitudinal force to the spine, a separation between spinal segments produces several physiological effects.[18, 20, 57, 58]

1) Separation encourages overall spinal movement and movement between the individual segments of the spine.

2) One of the largest effects of spinal traction is its ability to help with disc injuries and disc pain. It is theorized that the space created between spinal segments decreases the amount of pressure on the

discs and creates space for any bulging discs to return to a more "normal" state.

3) The distraction of the discs allows for healthy movement of fluid in and out of the joint space.

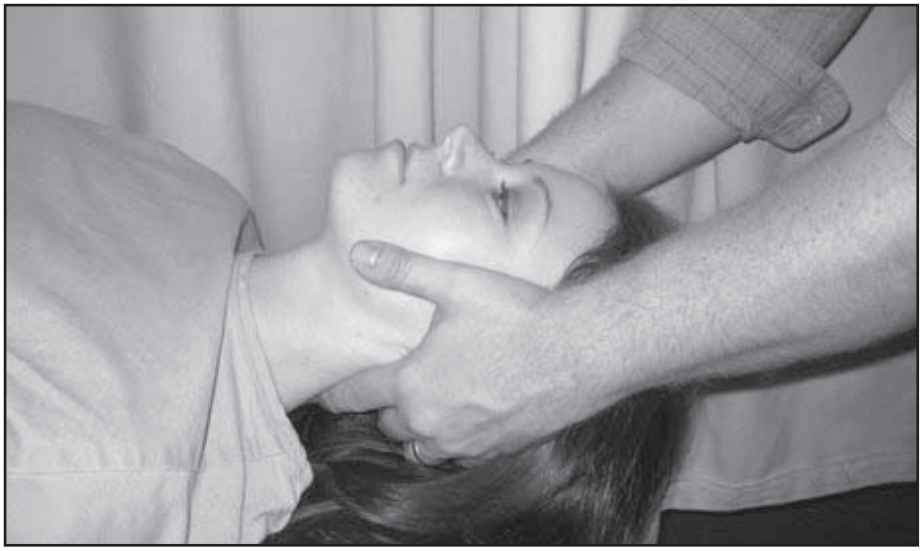
4) Spinal traction can help to restore normal length and function of the ligaments along the spinal column.

5) In addition to taking pressure off of the disc space, traction takes pressure away from the facet joints where cartilage and synovial tissue often become compressed or impinged. By separating the facet joints, practitioners can remove pressure from the structures that are often the primary pain generators.

6) Nerve irritation is often created by pressure from bulging discs, inflamed and degenerated facet joints, spinal stenosis, and bone spurs. This pressure often causes numbness, tingling, weakness, and pain. When this irritation is removed, imflammation decreases and the nerve function can be restored by the pressure reduction.

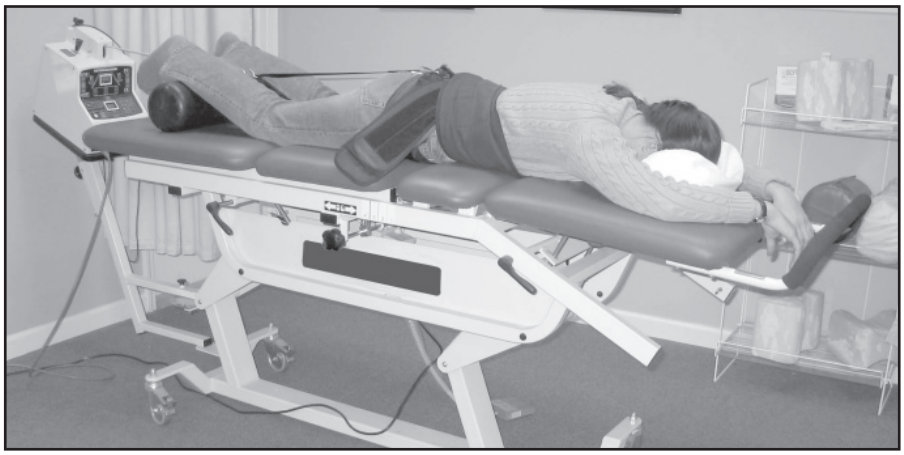
Forms of Traction

There are many forms of traction, including: manual; continuous (sustained); intermittent; and spinal decompressive traction. **Manual traction** is the practitioner's application of a force to the spine to passively distract the vertebra.[18] **Continuous traction** uses a device, such as a weight and pulley system, over-the-door traction unit, or some form of pneumatic unit. Pneumatic units utilize a sustained pull to distract the vertebra segments and apply a tension that does not alter over time until the treatment is over.[18] **Intermittent traction** can be applied by the practitioner or a mechanical device which has a cycle of "On/Off" whereby the "On" cycle causes the distraction, and the "Off" cycle allows the segments and surrounding soft tissue to relax.[18]



Manual Traction

Spinal decompression is a variation on conventional traction, and is having a great deal of success due to its ability to reduce the amount of muscle guarding that often decreases the effectiveness of traditional traction. The motor head of the table is computer controlled and utilizes intervals of distraction and relaxation that gradually builds tension to prevent the surrounding musculature from tightening or fighting the pull of the machine. This gradual increase in pull is more effective at a lower weight, but also reduces patient discomfort during and after treatment. See Figure 7.u for indications and contraindications for spinal traction. [55,56,57,58]



Prone Lumbar Traction Setup

Figure 7.u

Indications and Contraindications for Traction [18, 20]

Indications

- Degenerative disc disease
- Herniated discs
- Nerve root compression
- Degenerative joint disease
- Facet joint inflammation
- Muscle spasm

Contraindications

- Primary or metastatic malignancy
- Cord compression
- Infectious disease of spine
- Cardiovascular disease
- Severe arthritis
- Pregnancy
- Active peptic ulcers
- Hernia
- Aortic aneurysm
- Gross hemorrhoids
- Osteoporosis
- Vertebral fractures
- Acute injury
- Unstable spine
- Certain shoulder injuries (prone position)

Treatment Tip:

In order to avoid discomfort after decompression, allow the patient's body to "recompress" before they get off the table. If a patient stands too quickly, he or she might feel like his/her back "catches" or that everything that was stretched jams back together upon standing. One way to help is to keep the patient on the table a few minutes and have the patient perform isometric abdominal squeezes and buttock squeezes to stabilize the spine.

Treatment Setup

Applying traction to a patient with a warranted spinal condition can be highly beneficial; however, caution must be taken. The most common mistakes made during the application of long axis traction are setting the wrong poundage, the wrong time, and/or the wrong angle of pull. Correct angle of pull and tension applied to the spine is imperative when using traction. There are many brands of traction and spinal decompression devices available, and exact poundage and angle of pull varies among machines. The manufacturer's manual should be consulted prior to any application to ensure safety. There are some basics of setup that are universal and will be reviewed. [18, 20]

1) Make sure the patient has been asked about any contraindications.
2) Identify the patient's body weight.
3) Remove all forms of metal, necklaces, earrings, umbilical rings, or apparel that could interfere with procedure.
4) Lay the proper harness configuration or cervical mechanism on the table conducive to the patient positions ordered by the clinician.
5) Lay the patient supine, prone, or on his/her side, with proper pillow supports for comfort.
6) Make sure all the pieces of the machine are intact and in good working order.
7) For cervical or lumbar traction, set the table height for the proper angle of pull specific to the patient's condition.
8) Place the safety switch in the patient's hands and explain its purpose.
9) Explain the purpose of the treatment and what the patient should expect.
10) Reset and "zero out" the machine.
11) Set the controls or presets in accordance with the clinician's orders.
12) With lumbar traction/decompression, unlock the table in accordance with the manufacturer's recommendations.

Caution:
Any increase in back pain, leg pain, arm pain, headache, dizziness, or change in skin color is a **"Red Flag"** and treatment should cease immediately.

13) During the treatment, check on the patient to ascertain his/her comfort.

14) **Lumbar traction:** When the session is complete, lock the table, gently pull the rope loose, take off the harness, allow the patient to lie there for a minute to re-compress, have the patient perform isometric abdominal and gluteal contractions to stabilize the segment. Then have the patient turn to his/her side while exhaling, and push himself/herself upright to a seated position, prior to standing.

Supine Lumbar Traction Setup

Note:
To be effective, the pull should be at least a quarter of the patient's body weight. The majority of lumbar treatments use a force of 65 to 200 pounds. Cervical traction typically pulls at a rate between 10 and 30 pounds. Manufacturers and clinician's discretion are required for exact poundage.

15) **Cervical traction:** When the session is complete, gently release the rope, loosen the head harness and neck unit. Allow the patient to lie there for one minute to re-compress and have the patient perform gentle isometric neck retractions to stabilize the segment. Help the patient up from the unit.

Intersegmental Traction

Intersegmental traction (IST) uses a system of rollers to create a wave-like motion to the spinal segments. This motion helps to gently stretch the ligaments and muscles of the spinal column and creates better movement of the individual spinal segments. This treatment is very relaxing for patients and can increase mobility and reduce stiffness.

Intersegmental traction is one of the most widely used modalities common to the chiropractic practice. The rollers are designed to successively tilt each vertebra to induce movement between the spinal segments. This repetitive action increases the pumping action of the discs known as imbibition. This pumping action is responsible for the infusion and expulsion of extraspinal fluid from the spinal discs. Imbibition allows nutrient-rich fluid to enter the disc and toxic laden fluid to be expressed from the disc as a result of the variations in pressure.

Application

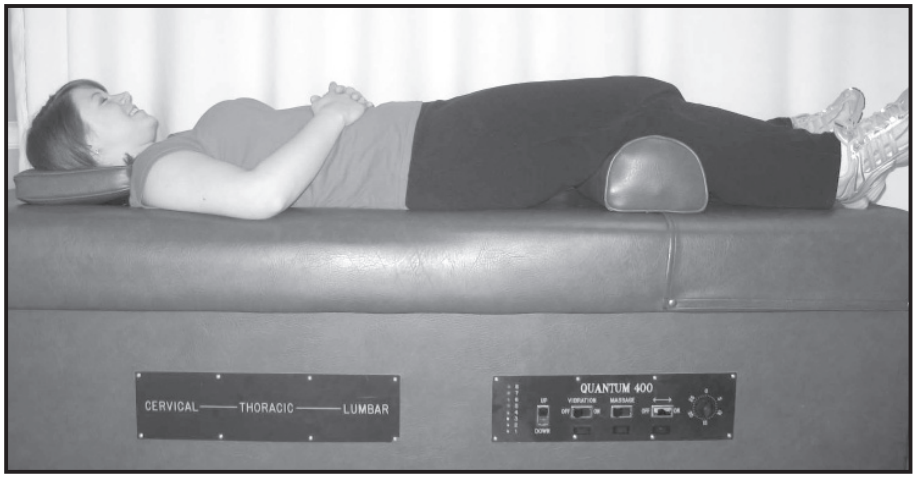
Depending upon the design of the particular table, the patient is instructed to sit either in the center or at the lower end of the table. They will lie back until they are properly positioned with the roller area of the table beneath his/her spine.

The timer is adjusted to the pre-determined setting, usually 5-20 minutes. The unit is then activated and the therapist adjusts the height of the rollers. The setting should be high enough to obtain the intended rocker-action effect but low enough to avoid patient discomfort.

In addition to inducing imbibition into the spinal discs, the unit acts to repetitively separate and distract the facet joints as the rollers activate each spinal segment. The rollers are shaped to apply a therapeutic kneading pressure to the paraspinal muscles to reduce edema, reduce adhesions, and stimulate lymphatic circulation.

Some intersegmental traction units also incorporate infrared heat that can be applied to the patient's back during treatment. Some clinics combine electro-stimulation with intersegmental traction by applying the electrical stimulation pads prior to positioning the patient on the intersegmental traction table.

See Figure 7.v for indications and contraindications for intersegmental traction.



Intersegmental Traction

Figure 7.v

Indications and Contraindications for IST

Indications

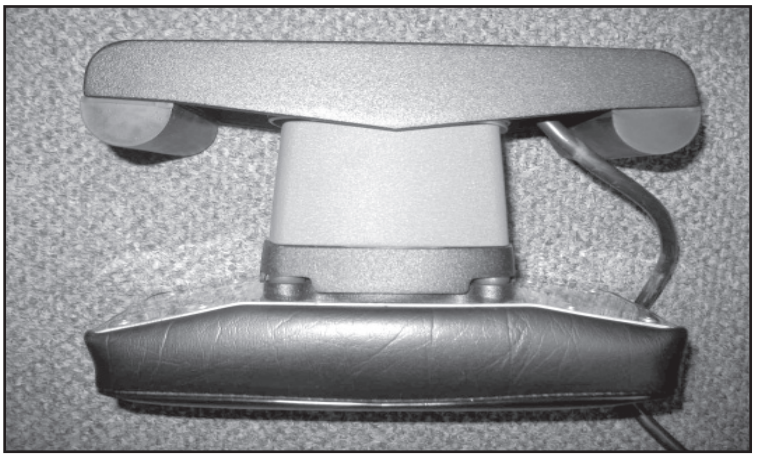
Muscle stiffness
Joint hypo-mobility
Ligament stiffness
Osteoarthritis (minimal to moderate)

Contraindications

Acute inflammation
Spinal fractures
Joint instability
Osteoporosis (moderate-severe)
Spinal cancers
Pregnancy

Other Common Chiropractic Modalities

There are a number of other modalities that are commonly used in the chiropractic rehabilitation setting. Most of these use some form of vibration, percussion, or massage to create their desired effect.



Vibration Massage Tool (Jeanie Rub)

Devices that create a **vibration** are good for reducing superficial muscle tightness and increasing circulation to the desired area. These are often handheld massagers that are used both in the clinic and at home. The Jeanie Rub is an example of a device that uses vibration. Other handheld massagers use **tapotement**, or percussion, to provide a deeper massaging action. This deep tapping action also helps with muscle tightness,

Figure 7.w

Indications and Contraindications for Handheld Massagers

Indications

Muscle spasms	Muscle stiffness
Trigger points	Myofascial release
Increasing circulation	

Contraindications

Fractures	Acute inflammation
Open wounds	Cancers
Increased symptomatology	

trigger point, myofascial release, and increased circulation. Devices that use this form of therapy include Jeanie Rub, G5 massagers, The Thumper, Arthrostim, and percussors (See Figure 7.w for indications and contraindications).

Safety Precautions

The goal of therapeutic modalities is to decrease healing time, reduce pain, and encourage wellness. To provide the safest environment for this to occur, certain safety precautions should be followed.

1) Chiropractic therapy is guided by **patient comfort**. Listen to the patient when he/she says something is uncomfortable or does not feel right, and adjust the treatment as necessary.

2) All equipment should be inspected regularly for damage to cords and wires. The machines should receive maintenance or be calibrated according to the recommendation of the manufacturer, typically once per year.

Caution:
Electrodes need to be replaced regularly as their ability to distribute electrical current fails over time. Always use caution when using "disposable" or "single use" electrodes. Follow the manufacturer's instructions closely.

3) All therapists should be properly trained on the function and application of each modality. It is important to understand the goal of each treatment and to only apply those therapies that will be beneficial to the patient.

4) The chiropractic physician will prescribe the therapeutic modalities that they deem are most beneficial for the patient, based on the patient's condition and goals of care. Only those modalities prescribed should be applied to the patient.

5) It is advisable for a staff member or doctor to "test" each modality on a regular basis by having it applied to themselves. This will reveal any abnormalities or subtle changes in function that might not be recognized by patients.