DOWNLOAD PDF BIOMECHANICAL DYSFUNCTION OF THE CERVICAL SPINE

Chapter 1 : Cervical Spine Functional Anatomy and the Biomechanics of Injury Due to Compressive Loadin

spine injuries were investigated in this work by reconfiguring an existing detailed biomechanical model of the human neck to simulate injuries to particular structures, and to model abnormal muscle activation.

Let us consider how the chronic shortening of just one muscle, which happens to be a core muscle, can impede performance and cause imbalances that lead to injuries. The rectus abdominis is a good example of an over worked muscle. As this muscle is overworked, the other core muscles are often ignored. It is imperative to train the core in a multi-planar fashion, especially the transverse plane, in order to create stabilization in the trunk, and in effect more optimal posture, strength and motion in the entire body. The following is a common example of the result of overworking the rectus abdominis. A tight rectus abdominis, when creating tension, or pull, on its upper and lower attachments, including the anterior pelvis, anterior ribs and inferior sternum, produces a flexion force in the trunk. This has consequences beyond the immediate structures affected. These consequences include a chain of effects that begin with shortening and tightening of the pectoral muscles. These muscles will exert an inferior tension on the clavicle, superior ribs and the anterior scapula and will assist in internally rotating the humerus. The force of gravity also contributes to the internal rotation of the glenohumeral, or shoulder joint, as the trunk flexes forward. Internal rotation of the humerus tensions and lengthens the external rotators of the shoulder which in combination with the tension exerted on the anterior scapula by the pecs, will bring the scapula into protraction, lengthening and weakening the middle and lower trapezius and rhomboid muscles note that a tight latissimus dorsi can also be a primary contributor to internal rotation of the humerus. The internally rotated humerus and protracted scapula will place the rotator cuff muscles at a biomechanical disadvantage in dynamically stabilizing the glenohumeral joint. The cuff will not function effectively, increasing the risk of injury. The reaction of the cervical spine is two-fold. The lower segments of the cervical spine follow the forward and downward movement of the trunk, and they themselves flex, causing lengthening and weakening of the deep cervical flexor muscles. This can also stress the outer layer of the intervertebral discs, which over time, may lead to injury. Of course, if the lower cervical spine flexes forward, the head will follow, and if this force is not countered, gravity will cause the head to fall forward. In order to prevent this from happening, tension will develop in the cervical extensors, including the upper trapezius, splenius, semispinalis, spinalis and sub-occipital groups, which attach to the base of the skull. The upper cervical segments including the base of the skull are extended, shortening the sub-occiptal muscles. This extension will allow the skull to remain somewhat level as it rests on the atlas, or the uppermost cervical vertebra. The overworking of the upper trapezius muscle and lengthening and weakening of the middle and lower trapezius and the rhomboids will also contribute to early elevation of the scapula with shoulder motion. This will worsen the position of the glenohumeral joint and will further stress the rotator cuff. Although this example has been limited to the rectus abdominis, it is important to understand that single muscles are rarely the isolated culprits in postural distortions and biomechanical dysfunction. An exception would be an acute specific muscle injury that has not healed correctly and has caused compensatory overloading in other areas. Because muscles act synergistically and as agonists and antagonists, there is usually more than one contributor. There are also connections between muscles through tough fascial connective tissue, which help to transmit forces between tissues. These cases of dysfunction can be rooted in other parts of the body, as the musculoskeletal system functions as a whole. Not only will these faulty positions and compensatory biomechanics cause an athlete to move inefficiently. Over time they may lead to degenerative processes in the soft tissues and joints that will lead to further injury and impairment. The neurological system also adapts to these changes, applying muscle memory, as it controls the musculature. Training this system is essential in developing healthy neurological pathways and muscle firing patterns. This is achieved through the methods mentioned above â€" using medicine balls, balance boards and stability balls and challenging the neuromuscular system. Any of the muscles mentioned above may be the source of dysfunctional patterns.

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Chapter 2 : The Spine: Anatomy, Biomechanics, Assessment, and Adjustive Techniques | Musculoskeletal

The biomechanical aspects of the clinical diagnosis of minor cervical spine injuries were investigated in this work by reconfiguring an existing detailed biomechanical model of the human neck to.

The new term is biomechanical lesion and the code is M99, with decimal designations used for various sections of the body â€” e. It is thought that the ICD system will be required sometime in More than a few chiropractors, myself included, feel this change in nomenclature is much-needed. Such a maldescriptive phrase does nothing to clear up the confusion and misconceptions associated with our work â€” misconstructions that only contribute to the apprehension and fear many feel when considering our profession. Such vague and indistinct terminology also discourages appropriate referral from other health care providers. Important also is the current void in understanding that exists between chiropractic providers and the insurance industry. Complicating all this is the insistence by some in our profession that others conform to our definition of the word subluxation, which is in conflict with the accepted medical definition. The natural reaction in others to such uncertainty, obscurity, confusion and doubt is a hesitancy to involve oneself in such dealings, further isolating our profession and hindering growth. Mechanical engineering disciplines such as continuing mechanics, mechanism analysis, structural analysis, kinematics and dynamics play prominent roles in the study of human biomechanics. Above all else biomechanics is the study and appreciation of functional order and disorder of the human locomotion system. Interestingly, biological systems are usually considered much more complex than man-built systems. In the past several decades, a great amount of research has been done in the field of sports biomechanics, with emphasis on reducing injury, rehabilitation following injury, and enhancing sports performance. The biomechanics of the human being is a core part of the study of kinesiology. Disturbed biomechanics is an integral part of determining permanent impairment following trauma such as motor vehicle crash. In short, biomechanical is now a widely understood and easily comprehended term with 40 years of usage; there is no ambiguity or uncertainty in its definition. It is interesting to note that in describing the conditions they treat with manual methods of adjustment and mobilization similar to ours, our philosophical cousins, osteopathic physicians, have long used the term osteopathic lesion. Biomechanical Lesion The term spinal biomechanical lesion then would imply a pathological condition involving discontinuity loss of cohesion of tissue, and loss of normal vertebral joint function kinesio-pathology that often has injury as its cause. It is a very descriptive term, and one that should be well-understood by any and all who have training and study in the field of medical terminology. The Subluxation Unfortunately, there will be those within the chiropractic profession who will resist, if not vehemently oppose, the use of this new diagnostic term. They will insist that any deviation from using the term subluxation is professional heresy and that any who propose such a change are working against the best interests of the profession. As we know, this is simply not the case for the conditions we commonly treat. Conclusions and diagnoses drawn from minuscule differences in measurement of anatomical landmarks taken from neutral-static X-ray images methods many of us were taught in school have little or no basis in science. Such anatomical measurements are, for the most part, simply not reliable in identifying regions of functional loss and biomechanical lesion formation. One must rely on skilled, experienced and artful palpation to discern regions of biomechanical impairment in the spine or elsewhere, perhaps aided by weight-bearing X-ray imagery. Lines of mensuration on functional or motion studies to determine ligamentous laxity and permanent biomechanical impairment, and standard orthopedic lines of normal positional relationships and angles, are exceptions. I am sympathetic to those who want to prosper the word because of its supposed connection to the concept of somatovisceral reflex. The profession can no longer afford to embrace a primary diagnostic term that only adds to the confusion and distrust of our motives and methods. Quibbling over semantics in disregard of harsh, punishing reality makes absolutely no sense. There is already enough misunderstanding, distrust and misconception about what we do. Why add to the confusion? This is especially true as regards interprofessional communications and relations. Please forgive me for observing, but in the larger world of health care delivery, beyond the somewhat narrow and at times myopic confines of chiropractic circles, the term subluxation has become a millstone, if not an albatross around our necks. Clearly, it is time to put the term to rest.

Chapter 3 : The Biology and Biomechanics of the Spinal Degenerative Cascade | Neupsy Key

Data Sources: We conducted literature searches through the Index Medicus, SPORT Discus, and PubMed databases and the Library of Congress from using the key phrases cervical spine injury, biomechanics of cervical spine, football spinal injuries, kinematics of the cervical spine, and axial load.

Visible, palpable spinous process step listhesis, not necessarily hypermobility or instability Palpable mobility Visible band of hypertrophied muscle at the level of instability Observe side of patient active flexion for sudden shake or catch Observe behind patient active flexion for side bending, may represent facet hypermobility on the opposite side Palpate for step forward or rotation; if persistent in standing and prone i. Segmental kyphosis greater than 11 degrees Anterolisthesis greater than 3. However, more advanced detail imaging such as dynamic imaging, MRI, CT and studies with contrast, is often necessary to detect instability13 3. The use of stem cells in spine surgery has now become widespread, but is not yet in routine clinical use in spine surgery. Mesenchymal stem cells possess the ability to regenerate bone, cartilage, and fibrous tissues. There are currently several studies on clinicaltrials. More research is needed to validate the potential benefits of using stem cells to improve spine instability. Therefore, there is no consensus about the timing of conservative versus surgical treatment in spine diseases with covert instability. The understandings of spinal biomechanics need improvement to determine and differentiate the relationship and severity between radiographic instability and its clinical manifestation. This gap in knowledge creates a burden for all disciplines involved in the diagnosis and treatment of patients suffering from disorders of spine stability. The Stabilizing System of the Spine. Function, Dysfunction, Adaptation and Enhancement. Journal of Spinal Disorders and Techniques ;5 4: Biomechanical analysis of clinical stability in the cervical spine. Clin Orthop Relat Res. Spinal Instability as Defined by the Three-column spine concept in acute spinal trauma. Clinical Orthopedics and Related Research ; Pakzaban P, Kopell BH. Spinal Instability and Spinal Fusion Surgery. The Canadian C-spine rule for radiography in alert and stable trauma patients. Selective cervical spine radiography in blunt trauma: Clinical instability of the lumbar spine: Ortho Phys Ther Pract. Physical signs of instability. Instability of the Lumbar Spine. Clinical Orthopedics and related research J Man Manip Ther.

Chapter 4 : Biomechanics of the Senescent Spine | Clinical Gate

Functional anatomy and biomechanics of the cervical spine The curvature in the cervical spine is called Chronic respiratory dysfunction leads to increased.

Show full item record Abstract Aims: The primary physiotherapeutic aims of the study were to validate a manual physiotherapy evaluation technique in the assessment of cervical biomechanical dysfunction, and to test the effectiveness of a manual physiotherapy treatment technique in the correction of cervical biomechanical dysfunction. The primary educational aims were to test the effectiveness and safety of a therapeutic exercise programme for the correction of biomechanical dysfunction as well as the effectiveness of a neck rehabilitation programme for improving neck muscle strength. A four group experimental design with three pre-test - post-test groups and a control group was used for the investigation. The subjects were South African schoolboy rugby players between the ages of 15 and 18 years. Groups I and 2 presented with biomechanical dysfunction of their cervical spines, Group 3 had no biomechanical dysfunction of their cervical spines and the players of Group 4, the control group, presented with or without biomechanical dysfunction of their cervical spines. Each group consisted of 25 players. Group I received manual physiotherapy with x-rays before and after treatment. Groups 2 and 3 performed a therapeutic exercise programme, with before and after x-rays, and Group 4 received no intervention between their sets of x-rays. Following the second set of x-rays all the players from Groups I, 2 and 3 performed the neck rehabilitation programme after which a third set of x-rays were taken. The results validated the manual physiotherapy evaluation technique. The manual therapy treatment technique used in the treatment of Group I showed highly significant improvements in cervical biomechanical function. Results for Group 2 following the therapeutic exercise programme showed moderate practically significant improvements in cervical biomechanical dysfunction. The therapeutic exercise programme for the correction of biomechanical dysfunction was found to be very safe with only small significant changes in x-ray measurements Group 3. The results of the control group showed a negative trend of small statistical significance. A highly significant improvement in cervical circumference as moderate significant improvement in biomechanical function was found following the neck rehabilitation programme. It could therefore be concluded that the manual physiotherapy evaluation technique for motion segment analysis was indeed valid in determining biomechanical dysfunction of the cervical spine. The manual physiotherapy treatment technique as well as the therapeutic exercise programme for the correction of biomechanical dysfunction was found to be effective in the correction of cervical biomechanical dysfunction. It could further be concluded that the therapeutic exercise programme was safe to be performed by players without biomechanical dysfunction. The neck rehabilitation programme was effective in improving cervical circumference as well as cervical biomechanical function.

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Chapter 5 : Mid-Thoracic Dysfunction â€“ Dr. Stefanie's Blog

The functions of the cervical curve and the anterior-to-posterior (A-P) curves throughout the spine are to add resiliency to the spine in response to axial compression forces and to balance the center of gravity of the skull over the spine.

Find articles by Beth A. Manuscript received February 12, ; final manuscript received June 21, ; published online August 2, Short abstract The facet joint is a crucial anatomic region of the spine owing to its biomechanical role in facilitating articulation of the vertebrae of the spinal column. It is a diarthrodial joint with opposing articular cartilage surfaces that provide a low friction environment and a ligamentous capsule that encloses the joint space. Together with the disc, the bilateral facet joints transfer loads and guide and constrain motions in the spine due to their geometry and mechanical function. Although a great deal of research has focused on defining the biomechanics of the spine and the form and function of the disc, the facet joint has only recently become the focus of experimental, computational and clinical studies. This mechanical behavior ensures the normal health and function of the spine during physiologic loading but can also lead to its dysfunction when the tissues of the facet joint are altered either by injury, degeneration or as a result of surgical modification of the spine. The anatomical, biomechanical and physiological characteristics of the facet joints in the cervical and lumbar spines have become the focus of increased attention recently with the advent of surgical procedures of the spine, such as disc repair and replacement, which may impact facet responses. Accordingly, this review summarizes the relevant anatomy and biomechanics of the facet joint and the individual tissues that comprise it. In order to better understand the physiological implications of tissue loading in all conditions, a review of mechanotransduction pathways in the cartilage, ligament and bone is also presented ranging from the tissue-level scale to cellular modifications. With this context, experimental studies are summarized as they relate to the most common modifications that alter the biomechanics and health of the spineâ€"injury and degeneration. In addition, many computational and finite element models have been developed that enable more-detailed and specific investigations of the facet joint and its tissues than are provided by experimental approaches and also that expand their utility for the field of biomechanics. These are also reviewed to provide a more complete summary of the current knowledge of facet joint mechanics. Overall, the goal of this review is to present a comprehensive review of the breadth and depth of knowledge regarding the mechanical and adaptive responses of the facet joint and its tissues across a variety of relevant size scales. Introduction The zygapophyseal, or facet, joints are complicated biomechanical structures in the spine, with complex anatomy, mechanical performance and effects on overall spine behavior and health. At each spinal level, there is a pair of facet joints located on the postero-lateral aspects of each motion segment, spanning from the cervical to the lumbar spine Fig. These facet joints are typical diarthrodial joints with cartilage surfaces that provide a low-friction interface to facilitate motion during normal conditions in a healthy spine. The kinematics and mechanical properties of the facet joint and its tissue components have been studied extensively for a variety of different loading conditions [1â€"11]. Recently, there is growing interest in the facet jointâ€"its biomechanics and physiologyâ€"with the advent of disc arthroplasty and there has been increased attention to the relationship between spinal degeneration and its effects on the mechanical environment of the different tissues in the facet joint [12â€"16]. Therefore, it is the primary goal of this review to present an updated perspective of the anatomy and global mechanics of the spinal facet joint and its individual tissue components in conjunction with their loading during physiologic and nonphysiologic motion. In addition, this review will summarize the mechanotransduction processes by which mechanical loading to the specific tissues of the joint translate into signals that drive physiologic responses in health, injury and trauma, and spinal degeneration. Computational models of the facet joint are also reviewed since there has been quite a bit of work in this area to complement and expand findings from biomechanical experiments and to provide insight about facet joint mechanics otherwise not measureable in typical cadaveric studies.

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Chapter 6 : Postural Distortion & Biomechanical Dysfunction

The biomechanical aspects of the clinical diagnosis of minor cervical spine injuries were investigated in this work by reconfiguring an existing detailed biomechanical model of the human neck to simulate injuries to particular structures, and to model abnormal muscle activation.

Find articles by Erik E Swartz R. T Floyd Find articles by R. Address correspondence to Erik E. Address e-mail to ude. This article has been cited by other articles in PMC. To provide a foundation of knowledge concerning the functional anatomy, kinematic response, and mechanisms involved in axial-compression cervical spine injury as they relate to sport injury. We conducted literature searches through the Index Medicus, SPORT Discus, and PubMed databases and the Library of Congress from â€" using the key phrases cervical spine injury, biomechanics of cervical spine, football spinal injuries, kinematics of the cervical spine, and axial load. Research on normal kinematics and minor and major injury mechanisms to the cervical spine reveals the complex nature of movement in this segment. The movement into a single plane is not the product of equal and summative movement between and among all cervical vertebrae. Instead, individual vertebrae may experience a reversal of motion while traveling through a single plane of movement. Furthermore, vertebral movement in 1 plane often requires contributed movement in 1 or 2 other planes. Injury mechanisms are even more complex. The reaction of the cervical spine to an axial-load impact has been investigated using cadaver specimens and demonstrates a buckling effect. Impact location and head orientation affect the degree and level of resultant injury. As with any joint of the body, our understanding of the mechanisms of cervical spine injury will ultimately serve to reduce their occurrence and increase the likelihood of recognition and immediate care. However, the cervical spine is unique in its normal kinematics compared with joints of the extremities. Injury biomechanics in the cervical spine are complex, and much can still be learned about mechanisms of the cervical spine injury specific to sports. A CSI requires an immediate and deliberate, yet sensitive, response. The highest rate of severe neck injuries has occurred in American football and rugby. White et al 12 defined clinical instability in the spine as more than a 3. Obviously, the athletic trainer is unable to detect the presence of such a diminutive irregularity in the structure of the spine and must, therefore, assume the worst-case scenario. Motion in one plane at the cervical spine requires the contribution of complementary motion from individual vertebrae in other planes. Considering the mechanism of injury is an important first step for the on-field assessment of any athletic injury. An athlete with a significant spinal cord injury may not immediately present with emergent signs and symptoms. Therefore, understanding the kinematics of the cervical spine is important for the athletic trainer, not only in helping to appreciate the following sections regarding injury mechanisms but also in allowing for a more effective evaluative tool after CSI. The purpose of this literature review is to provide a foundation of knowledge concerning the functional anatomy, kinematic response, and primary mechanisms involved in CSI during participation in sports, specifically as they relate to axial-compression forces. A secondary purpose of this review is to demonstrate the need for research investigating sport injury mechanisms of the cervical spine. Rotation to one side causes the contralateral occipital condyle to contact the anterior wall of its atlantal socket and the ipsilateral condyle to contact the posterior wall of its respective atlantal socket.