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The Predominant Factor Theory Reexamined

By Daniel C. Seemann, Ph.D.

The Predominant Theory

Reference to the predominant theory was first made in an article written by Gregory in 1969. Gregory wrote the predominant factor theory is based on the atlas subluxation complex and the planes of misalignment. "If the predominant excursion of the atlas is into either frontal plane, the leg on the opposite side of the body will be affected. If the predominant excursion is in the transverse plane (rotation) the leg on the side of the lateral misalignment will be contracted." Several hypotheses were generated from the article which are listed below.

1. If laterality is the predominant factor, leg shortness will be found on the side opposite of laterality.
2. If rotation is the predominant factor, leg shortness will be found on the same side as laterality.
3. With a type 2 subluxation, leg shortness will be ipsilateral.
4. With posterior rotations that are larger than laterality, leg shortness will be ipsilateral.
5. The odontoid and spinous are capable of decreasing or increasing the influence of laterality on the neurological component.
6. If reductions occurs in one plane but not the other, the opposite leg may shorten.

Relatively little has been done to test the above hypotheses since 1969. Seemann (1971) attempted to test two of the hypotheses but the results were not conclusive, because the sophistication about the atlas subluxation complex was not available at that time to determine the subtleties of the predominant factor theory. As our understanding about the basic types improved, more doors were opened such as with the center of gravity studies and the lever system articles. Further help came from an 1984 article (Seemann) where an attempt was made to predict how anterior and posterior rotations were produced. Two hypotheses were generated from this study. The first hypothesis considered the frontal plane by stating that if the center of gravity of the skull fell on the side of laterality, (the short axis) rotation would be anterior. (See Figure 1.) If the center of gravity of the skull fell on the side opposite to laterality, (long axis) the rotation would be posterior. (See Figure 2.)

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A Review of Non-Chiropractic Literature Having Importance for Upper Cervical Practitioners

By J. Palmer

Early medically-oriented scientific researchers have called the biomechanical aspects of the atlas subluxation complex the following: "rotation-subluxation," "vertebral blocking," "atlanto-axial rotary fixation," "rotary dislocation," "rotation deformity," "rotational subluxation," "unilateral atlanto-axial subluxation," and an "incongruity" between C-1 and C-2.[1-4,14] A "rotation-subluxation" for the atlas and axis pair is a fixed torsion between the two cervical vertebrae. This "rotation-subluxation" is "vertebral blocking" in an abnormal position and may lead to compression-symptoms in the suboxial intervertebral joints.[1] Wortzman states the outstanding feature of "rotary fixation" is that of the atlas on the axis in a position normally attained during rotation.[2] Fielding and Hawkins prefer the term "atlanto-axial rotary fixation" since "the fixation of the atlas may occur with subluxation or dislocation or when the relative positions of the atlas and axis are still within the normal range of rotation."[3]

Fielding and Hawkins state that rotary deformities of the atlanto-axial joint are usually short-lived and easily correctable; rarely do they persist causing torticollis which is resistant to treatment.[3] In the Fielding and Hawkins study the onset of rotary deformities was spontaneous in four patients, was associated with an upper respiratory-tract infection in five, minor trauma in three, and major trauma in two. In the other three patients onset followed the application of an orthodontic device surgical repair of cleft palate, and removal of a body cast during treatment of scoliosis. The average delay in diagnosis was 11.6 months. The typical head position is called the cock robin position.

Torklus and Gehle have stated that because the atlas acts like a turn-table between head and axis it is easy to understand that vertical, oblique, or lateral forces acting on the atlanto-occipital and atlanto-axial joints can produce "rotation-subluxation". Additionally they have stated that if there is a persistent tendency towards rotational displacement at C1/C2 without locking, then there is a habitual rotational subluxation of the upper cervical spine.[1]

Dvorak, Panjabi, Gerber and Wickmann have investigated rotary instability of the upper cervical spine by using

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The Predominant Factor Reexamined

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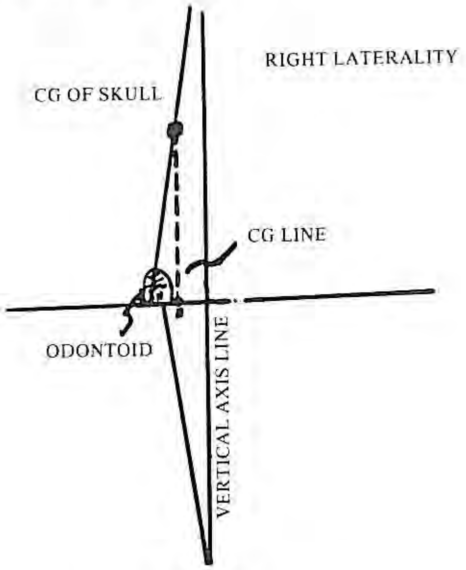

Figure 1.
Center of gravity basic type 2 subluxation. Side of laterality.

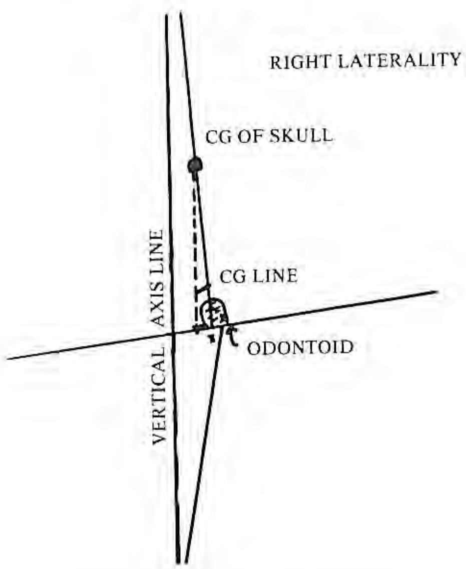

Figure 2.
Center of gravity basic type 1 subluxation. Side opposite laterality.

An hypothesis was also made for the sagittal plane which stated that if the center of gravity of the skull fell anterior to the odontoid process, the rotation would be anterior and if the CG of the skull was posterior to the odontoid rotation would be posterior.

These hypotheses were basically supported with an analysis of 1000 cases which showed that 68% of all posterior rotations are Type 1 subluxations and that about 75% of all Type 2, 3, 4 subluxations are anteriors.

The reader is probably wondering at this point what this has to do with predominant factors, but our knowledge about where the CG of the skull falls in relation to laterality and rotations are produced with regard to the long axis and short axis gives clues as to how the predominant excursions are produced.

For an example, recall that one of the hypotheses from the Gregory article (1969) states that with a Type 2 subluxation leg shortness would be ipsilateral. With more information on how subluxations are produced, an analysis of the biomechanics can be made. With the Type 2 subluxation, the CG of the skull falls on the same side of laterality in the frontal plane, the plane line is level and the rotation is anterior. This is true in about 75% of the Type 2 cases.

As to why Type 2's are ipsilateral the answer is more complicated. It is felt that ipsilateral short legs are more detrimental neurologically, because the head turns on the atlas condyles causing foramen magnum pressure on the spinal cord.

Type 1 subluxations are biomechanically different than Type 2's, 3's and 4's. The CG of the skull falls to the opposite side of laterality in the frontal plane, the plane line is generally high on the side of laterality. Although 60% of the rotations are anterior, 68% of all posterior rotations are Type 1's.

Type 1's tend to be contralateral, because of the biomechanical relationship mentioned above. As a result of this arrangement, it is thought the pressure caused by the subluxation is less detrimental neurologically than with the Type 2's, 3's and 4's. There is less turning of the head on the atlas condyles and more of the atlas accounting for laterality, therefore less pressure caused by the foramen magnum.

The long axis and short axis theory on how rotations are produced presents some possibilities on why legs will shorten either ipsilateral or contralateral. It was hypothesized that if the CG of the skull falls to the side opposite laterality the atlas would tend to pivot at the condyle where the CG falls. In this case, it would be the long axis and would tend to produce posterior rotations.

If the CG fell on the same side as laterality, the condyle under the CG of the skull would be the pivot point for the atlas. This would be the short axis and tend to produce anterior rotations.

The import of knowing whether a subluxation is a short axis or long axis will help in determining where the pressure from the subluxation is located on the spinal cord. For an example, with the short axis, the atlas seems to impinge on the spinal cord to a greater degree than the long axis. The direction of the impingement more from an anterior position whereas the impingement for the long axis is more from a posterior position. This analysis although theoretical, may in the future, give insight as to why posterior rotations cause different pressures on the spinal cord than anterior rotations.

A Testing of Some of Original Hypotheses

With more information as to how the predominant factor works, a testing of some of the earlier hypotheses as proposed by Gregory were made.

The first hypothesis tested was "With a Type 2 subluxation leg shortness will be ipsilateral." From an N=333 (all Type 2's), there were 216 cases that were a left laterality and

114 cases that were right laterality which is a 65% to 35% ratio. Of the 216 cases that were left laterality, 98 cases (46%) were ipsilateral and 118 cases (54%) were contralateral. Of those 114 cases that were right laterality, 59 cases (52%) were ipsilateral and 55 cases (48%) contralateral. The total number of ipsilateral cases out of 333 Type 2 was 157 (47%). The conclusion from this analysis is the hypothesis should be rejected. The incidence of an ipsilateral short leg occurring is no greater than a contralateral short leg.

Type 3's were also examined as to whether the tendency for the leg to be ipsilateral. From an N=60 cases, 34 cases (57%) were left laterality and 26 cases (43%) were right laterality. Of the 34 cases, 12 cases (35%) were ipsilateral and 24 cases (65%) were contralateral. Of the 26 cases that were right laterality, 14 cases were ipsilateral and 12 cases (48%) were contralateral. 43% of all Type 3 subulations were ipsilateral. The hypothesis that Type 3 subluxations will tend to be ipsilateral should also be rejected.

It became evident in the above analysis there were too many variables to control for in this type of analysis. So a strategy was made for testing the relationship between laterality and rotation to determine short leg tendency. The strategy was to test two hypotheses that concern laterality and rotation. Basically, the hypotheses state: "If laterality is the predominant factor, leg shortness will be found on the side opposite to laterality and if rotation is the predominant factor, leg shortness will be found on the same side as laterality. The plan was to hold either of the variables constant while attempting to predict leg shortness. For an example, while using the computer it is possible isolate all listings that have a rotation of one. It is possible then to examine the effects of laterality with rotation being held constant. The below conditions were examined holding one or more variables held constant.

The Effects of Laterality With Rotation Held Constant

The below cases were examined with rotation held constant at one degree.

File number: 6726

Lat: R3	Od: R3	Sp: R3	Rot: A1
S Line: S5	La: L6	C/A: 3 7	
Plane Line:	H: 4	Type: 1	Lc: L.75

File 6726 is an example which supports the hypothesis: If laterality is the predominant factor, the leg will be short on the opposite side of laterality. The prediction is supported for several reasons: the spinous is = to laterality, laterality is greater than the rotation and subluxation type is 2.

File number: 6789

Lat: L3.5	Od: L3.5	Sp: L3.25	Rot: P1
S Line: S4	La: R8	C/A: 3 8	
Plane Line:	H: 6.75	Type: 1	Lc: R.75

File 6789 supports the hypothesis but the listing is different than above. The spinous is not = laterality and rotation is posterior.

File number: 6739

Lat: R2.5	Od: R2.5	Sp: R0	Rot: A1
S Line: S1	La: L3.5	C/A: 3 7	
Plane Line:	H: 4	Type: 1	Lc: R.5

File 6739 does not support the hypothesis. In this case the leg shortness is ipsilateral yet laterality is greater than rotation. The spinous is smaller than laterality. It was found in analyzing similar cases where the prediction was not supported the spinous was not = to laterality. The type of subluxation was a Type 1.

The last case study of this sequence illustrates a situation where laterality and rotation are equal as to the excursion into each plane. The problem then is how do you predict which is the predominant factor?

File number: 6721

Lat: L1	Od: L1	Sp: L1	Rot: A1
S Line: S3	La: L2.5	C/A: 3 8	
Plane Line:	H: 1.75	Type: 2	Lc: R1

Frontal: R2 Transverse: P2 Fixed Point: R4

File 6721 indicates that laterality and rotation are equal as to the excursion into each plane. Laterality and the spinous are equal. So what might be the deciding factor in why the leg shortness is contralateral? What makes the prediction more difficult is that the type subluxation is a Type 2. The head turning on the condyles should make the prediction ipsilateral. What we do not know in the listing is whether the plane line is involved, i.e., whether the skull has turned on the atlas condyles or the laterality is the result of the atlas moving into the left frontal plane. Whatever the analysis, the conclusion would have to be that the subluxation was a contralateral pressure.

The Effects of Rotation With Laterality Held Constant

The below cases were examined with laterality held constant at one degree. The prediction should be if rotation is the predominant factor, then leg shortness should be ipsilateral.

File number: 6734

Lat: L1	Od: L1	Sp: L1	Rot: A5
S Line: S3	La: L1	C/A: 3 6	
Plane Line:	H: 1.25	Type: 2	Lc: L.5

File 6734 is an example which supports the prediction. If rotation is the predominant factor, leg shortness will be ipsilateral. In this case, rotation is 5 degrees and laterality is 1 degree. The other major factor which supports the prediction is rotation is anterior and the subluxation is Type 2.

File number: 6729

Lat: R1	Od: R1	Sp: L0	Rot: A4
S Line: S4	La: R1	C/A: 3.5 1	
Plane Line:	H: 5.25	Type: 2	Lc: L1

File 6729 is an example where the prediction for ipsilaterality is not supported. Leg shortness is contralateral. It appears that rotation is the predominant factor. But note that the spinous is 0 degrees. Evidently with this case, the effects of the spinous are enough to offset the effects of the anterior rotation.

File number: 6666

Lat: R1	Od: R1	Sp: R8	Rot: A6
S Line: S4.5	La: L1.5	C/A: 3.5 7	
Plane Line:	H: 3.25	Type: 1	Lc: L1

File 6666 does not support the prediction even though there is an anterior rotation of 6 degrees and a laterality of 1 degree. There are two possibilities as to why this case is contralateral. Probably the biggest factor is the spinous is not equal to laterality (8 degrees) which perhaps offsets the effects of the rotation. The other factor is that since the case is a Type 1 subluxation, the skull laterality is due a shift in the atlas rather than the skull turning on the atlas condyles.

File number: 6721

Lat: L1	Od: L1	Sp: L1	Rot: A1
S Line: S3	La: L2.5	C/A: 3 8	
Plane Line:	H: 1.75	Type: 2	Lc: R1

File 6721 is difficult to predict because the ratio between rotation and laterality is equal. In this case the leg shortness is contralateral. This is surprising because the case is a Type 2 subulation. The only clue is the plane line might high.

Type 3 Subluxation With the Lower Angle Held Constant

The final analysis will examine Type 3 subluxations. The lower angle maybe another variable that needs to be considered with predicting leg shortness. It was also felt that the characteristics between Type 3's and Type 2's which are similar would help in understanding one of the original hypotheses which states that Type 2 subluxations will tend to be ipsilateral.

File number: 6598

Lat: R4	Od: R4	Sp: R4.5	Rot: P.5
S Line: S2	La: L0	C/A: 4 9	
Plane Line:	H: 2.75	Type: 3	Lc: R1

File 6598 supports the prediction that leg shortness should be ipsilateral. The first factor to note would be the amount of laterality, in this case 4 degrees. The plane line should be zero, so it can be assumed the skull is turning on the atlas condyles. If the rotation was anterior it would make the prediction easier, but evidently the .5 degrees posterior does not effect the pressure.

File number: 6563

Lat: L5	Od: L5	Sp: R4	Rot: A1
S Line: S3	La: 0	C/A: 3.5 8	
Plane Line:	H: 5.25	Type: 3	Lc: R1

File 6563 does not support the hypothesis. The leg is contralateral and this listing is difficult to explain. The large laterality and the anterior rotation would indicate leg shortness should be ipsilateral. There are two clues which makes leg shortness in this case, contralateral. The spinous is not = to laterality and it is not known if there might be a plane line that is not level.

File number: 6565

Lat: R1.5	Od: R1.5	Sp: R1	Rot: P3
S Line: S3	La: R0	C/A: 3.5 5	
Plane Line:	H: L.75	Type: 3	Lc: L.75

File 6565 does not support the hypothesis. Leg shortness is contralateral. There may be two factors which influence the predominant factor. There is a posterior rotation which may reduce the amount of pressure and again the spinous is not = to laterality. It is not known what the plane line is doing which would help the prediction.

Holding the lower angle constant does not seem to improve the prediction, which suggests there might be another variable involved with the hypothesis. The variables that leap out is we need to know more about the plane line and more about the spinous. In every case that was examined of a Type 3 subluxation the spinous was not equal to laterality. This characteristic should be studied further.

Some Observations

One factor that seems to always be present when a prediction does not hold is the spinous will not be equal to laterality. It does not seem to matter whether the spinous is larger than or smaller than laterality but the spinous will always be different than laterality if the prediction as to leg shortness is incorrect. For an example, the investigator was able to predict 86/89 cases when the spinous differential was part of the prediction.

What is interesting about the spinous involvement as to the predominant excursion is that Gregory noted in one of the original hypotheses (1969) "that the odontoid and spinous are capable of decreasing or increasing the influence of laterality on the neurological component." Further investigation of this influence is warranted.

With the new method of calculating the amount of the skull turning on the condyles of the atlas, the practitioner is now able to determine what amount of laterality is due to the shift of the atlas in the frontal plane or the skull turning.

Being able to determine the amount will give a clue to which leg will shorten. If there is a significant portion of laterality that is due to the skull turning, the prediction will be the leg will be ipsilateral.

Some other hypotheses have been gathered from this research. No speculation will be given as to why the pattern exists just that they were noted and will be studied further.

1. If laterality is a great deal larger than rotation and the rotation is anterior, leg shortness will be ipsilateral.
2. If laterality is a great deal larger than rotation, and the rotation is posterior, leg shortness will be contralateral.
3. If laterality ranges between 2.5 and 3.5 degrees and rotation is 1 degree, leg shortness will be ipsilateral.
4. If laterality is equal to rotation, it is very difficult to predict. An ipsilateral short leg in this type of case would indicate the predominant factor is laterality caused by the skull turning on the condyles.

Conclusions

The reader may come to the conclusion that the original hypotheses as generated by the Gregory article have not been supported. And a superficial view of the data would support this notion. Yet as we delve into the subtleties of the variables which were analyzed in this article it is the writer's belief the hypotheses will basically be valid. Future research will bear this out.

Research about the predominant theory is a significant first step. To be able to predict leg shortness as the result of knowing the biomechanics of the subluxation is known by very few.

References

[1]Gregory, R.R., The ASC and leg imbalance. The NUCCA NEWS, Vol. 1, No. 7, March 1969.

[2]Seemann, D.C., A Statistical Analysis of some hypotheses about the atlas subluxation complex. Paper presented at NUCCA convention May 1971, Monroe, Michigan.

[3]Seemann, D.C., Some Hypotheses as to How Rotations are Produced with Cervical Subluxations. Upper Cervical Monograph, Vol. 3, No. 8, June 1984.

[4]Gregory, R.R., The NUCCA advanced course: biomechanics. The National Upper Cervical Chiropractic Association; Monroe, Michigan, 1987.

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Non-Chiropractic Literature

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radiography, cinerodiography and computerized tomography on cadavers when an alar ligament is selectively ruptured.[5] Anterior movement of the atlas is primarily restricted by the transverse ligament and secondarily by the alar ligaments. The alar ligaments limit the axial rotation of the head, however, there is controversy about their anatomy.

Some researchers have described the alar ligament as the connecting tissue between dens axis and the occiput as well as between the dens and the lateral mass of the atlas; most of the anatomy textbooks describe the alar ligaments as being between only the dens and the occiput. It is known that the alar ligaments consist mostly of collagen fibers; collagen fibers are inelastic. Elastic fibers were found only in the marginal fibers. Dvorak et al state that the upper fibers of the alar ligaments usually are oriented crainocaudal to the condyles whereas the lower fibers are oriented almost horizontally.

Dvorak et al state that the alar ligaments could be irreversibly stretched when the head is rotated and flexed. It is possible that these ligaments are most vulnerable when the suboccipital musculature is mostly relaxed. One study mentioned by the researchers stated that if in a rear-end collision the driver's head is initially slightly axially rotated, then the head will undergo further rotation to the maximum; in frontal impact the head will be forced to the midline. The alar ligament can resist only 240N (about 54 lbs.) before failure; this contrasts with approximately 100-150N (22-34 lbs.) needed to reach the endpoint of axial rotation.

These investigators found from the CT scans that one-sided lesion of the alar ligament can result in increased axial rotation (approximately 10 degrees) of the occipital-atlanto-axial complex to the opposite side. They found that there is increased rotation between atlas and occiput as well as between axis and atlas and that the rotations are divided about equally. Lateral displacement of the atlas in rheumatoid arthritic patients is most probably caused by destruction of the alar ligaments.

Dvorak et al state that it is possible that the increased rotation can irritate not only the vertebral artery but also the vertebral nerve and the mechanoceptor and nociceptors of the apophyseal joint capsule resulting in symptoms such as headache and dizziness. It should be noted that maximum normal physiologic rotation of the head will fully stretch a vertebral artery.

Several observations are worthy of emphasis. Toggle manipulations are done because a subluxation is perceived to exist. Forgetting about the serious problems with directions of forces in a Toggle manipulation, one must be seriously alarmed by the force magnitude constraints of the endpoint of axial rotation (100-150 N) and the failure values for the alar ligaments (240 N). To add to this the fact that vertebral arteries can be severely compromised by excessive rotation especially if combined with anterior displacement of the atlas one cannot argue for this cave-man technique. How does one control the magnitude of a Toggle force?

It is interesting to this researcher to see the neurological mechanisms being suggested for the spine and, therefore, also for upper-cervical. Gracovetsky and Farfan suggest that information transmitted by the nociceptive receptor network may be stress because these receptors are ideally located to respond to stress in the muscles and/or the bones.[6] They believe that the preservation of the spine as a functional unit require that each intervertebral joint remain undamaged. This is accomplished by the joint reacting to internal stresses to control the force exerted upon it by an applied load in such a way as to minimize stress at the joint and to share stresses with other joints. They believe that a feedback mechanism could modify muscular activity and muscular activity could control the stress in the ligaments because it modifies spinal geometry. Their hypothesis implies that the central nervous system can monitor stress levels in the spine and then use this information to coordinate musculature activity in order to perform a task with the minimum equalized stress possible. Obviously this has implications for spastic contracture, especially if the nociceptive system is important for pain and stress.

Dillin states that cervical radiculopathy may be defined as pain in the distribution of a specific cervical nerve root as a result of compressive pathology whether from disc herniation, spur formation, or hypermobility states.[15] An estimated 51 percent of the adult population will experience neck and arm pain at some point. Cervical radiculopathy is initially managed by the use of soft collars and anti-inflammatory agents. It was found that wearing a collar often relieved pain but that any other or no treatment offered the same end result. Other investigators found that greater therapy was associated with a worse result.

A study done at Western Reserve University Hospital utilized NMR in the diagnosis of upper-cervical spinal cord compression.[16] NMR was found to be critically important because it provided a dynamic study evaluating the compression of neural tissue throughout the entire range of motion of the cervical spine. Clinical signs alone often cannot distinguish between anterior and posterior compression. Flexion demonstrates compression of the spinal cord and correlates more closely with the patients' neurologic status than did conventional radiography.

It is well-known that the spine (a flexible rod) bent in the sagittal plane subjected to a lateral bend by asymmetrical paraxial muscle activity will induce an axial torque.[6] Thus an alternating lateral bend in the lumbar spine results in the pelvis and shoulder rotating in the opposite direction while the spine flexes and extends in a known manner. Gracovetsky and Iacono believe that the spine and its ligaments are an energy storage device and that the motion of the spine precedes that of the legs (in locomotion).[8] One cannot but help think of the tricepts pull and the sternum-spinal motion. The spine effectively becomes the largest lever of the body.

Sherk has observed that many children with hydrocephalus and spina bifida have severe scoliosis and kyphosis.[9] He believes that it is likely that CNS lesions cause spinal deformity by disrupting coordinating control of spinal musculature by the normal postural reflex mechanisms. (Could not the sequence be: greater compression due to weight, changing center of gravity of the head resulting in greater potential for cervical subluxation, with concommitment scoliosis and CNS lesions?) The anatomic study showed extensive fibrosis and scarring of the upper cord and brain stem, but intraoperative studies showed that there is free transmission of a fluid pressure wave from the chord across the foramen magnum with a consequent rise in intracranial pressure.

Austin has stated that metrizamide, a water-soluble, nonionic contrast medium has extended the applications of computed tomography to allow consistent documentation of the subarachoid space and the spinal chord.[10] The normal cervical cord is oval and fills one-half to two-thirds of the spinal canal. At the cervicocranial junction the medulla is situated between the posterolaterally positioned cerebellar tonsils. According to Hensinger, Steele's anatomic studies provide a simple rule for evaluating the C1-C2 area.[11] Steele defined the "rule of thirds" on the area of the vertebral canal at the first cervical vertebrae can be divided into one-third cord, one-third odontoid, and one-third "space". The one-third space represents a safe zone in which displacement can occur without neurologic impingement and is roughly equivalent to the full transverse diameter.

Hensinger states that the C1-C2 articulation is the most mobile part of the vertebral column and consequently the least stable. The odontoid acts as a bony buttress to prevent hyperextension but the remainder of the normal range of motion is maintained and solely dependent on the integrity of the surrounding ligaments and capsular structures. Hensinger states that instability may follow inflammation since inflammation causes apparent or actual softening of the ligaments or their attachments. Twenty-five percent of Down's Syndrome patients have a laxity for the C1-C2 articulation. Anomalies of the odontoid can increase the stress of the C1-C2 articulation and lead to hypermobility and eventual frank instability.

Rheumatoid arthritis and Down's Syndrome all have cases with atlanto-axial dislocation.[12, 13] Rheumatoid patients with atlanto-axial dislocation and myelopathy most commonly have compression of the spinal cord at the C1 level. The cause of the atlanto-axial dislocation in Down's Syndrome is debated. Possibilities include laxity of the transverse ligament of the axis and abnormalities of the odontoid process. Reduction of the atlanto-axial dislocation are made difficult or impossible by entrapment of the transverse ligament under the anomolous bone or by the anteriorly inclined facet joints of the axis. In many cases the dislocation position is the most stable position of the atlas and the axis.

According to Hensinger, persons with basilar impression or atlanto-occipital fusion have the major neurologic damage occurring anteriorly from the odontoid with spasticity being one of the symptoms commonly found. If the primary area of impingement is posterior from the rim of the foramen magnum, dural band, or the posterior ring of the atlas there will be symptoms referable to the posterior columns with alteration of sensation for deep pressure, vibration and proproception.

Some interesting articles have appeared on spinal measurement.[17, 18] Stokes et al have developed a method for measuring the axial rotation of vertebrae in degrees by a stereo technique that is of help in measuring scoliosis.[17]

Research on upper cervical still appears to be a small fraction of that on lumbar studies. Over 600,000 lumbar spinal radiographs are taken annually in the United States; however, the value of this examination in the diagnosis of low back pain is debatable.[18] No more than 1 in 1000 spinal radiographs yields critical diagnostic information or alters the course of treatment. Frymoyer's study confirms that radiographs have minimal value in determining who has had or is having low-back pain.

Much research has recently been done on the biomechanics of the human shoulder complex and modeling of the shoulder.[8, 19-22] This is encouraging to this researcher because a scientific biomechanical analysis of the tricepts pull seems to be just around the corner.

Research

[1]Torklus, D., Gehle, W. The Upper Cervical Spine, Grune and Stratton, 1972.

[2]Wortzman, G., Dewar, F., Rotary Fixation of the Atlanto Axial Joint: Rotational Atlantoaxial Subluxation. Radiology, 1968, 90, 479-487.

[3]Fielding, J.W., Hawkins, R.J., Atlanto-Axial Rotary Fixation. J. Bone and Joint Surgery, 1977, 59-A, 37-44.

[4]Fielding, J.W. et al, Use of Computed Tomography for the Diagnosis of Atlanto-Axial Rotary Fixation, J. Bone and Joint Surgery, 1978, 60-A, 1102-1104.

[5]Dvorak, J. et al, CT-Functional Diagnostics of the Rotary Instability of the Upper Cervical Spine: 1. An Experimental Study on Cadavers. Spine, 1987, 12, 197-205.

[6]Gracovetsky, S., Farfan, H. The Optimum Spine. Spine, 1986, 11, 543-573.

[7]Gracovetsky, S., Iacono, S. Energy Transfers in the Spinal Engine. J. Biomed. Eng., 1987, 9, 99-114.

[8]Engin, A., Peindle, R. On the Biomechanics of Human Shoulder Complex-I. Kinematics for Determination of the Shoulder Complex Sinus. J. Biomech., 1987, 20, 103-118.

[9]Sherik, H. et al, Hydrocephalus, Cervical Cord Lesions, and Spinal Deformity. Spine, 1986, 11, 340-342.

[10]Austin, G. The Spinal Cord, Igaku-Shoin, New York, 1983.

[11]Hensinger, R., et al, Osseous Anomalies of the Craniovertibral Junction. Spine, 1986, 11, 323-333.

[12]Toolanen, G., Larsson, S-E., Fagerlund, M., Medullary Compression in Rheumatoid Atlanto-Axial Subluxation Evaluated by Computerized Tomography. Spine, 1986, 11, 191-194.

[13]Kobori, M., Takahashi, H., Mikawa, Y., Atlanto-Axial Dislocation in Down's Syndrome: Report of Two Cases Requiring Surgical Correction. Spine, 1986, 11, 195-200.

[14]Clark, C., et al, Atlantoaxial Rotatory Fixation with Compensatory Counter Occipitoatlanto Subluxation: A Case Report. Spine, 1986, 11, 1048-1050.

[15]Dillin, W., et al, Cervical Radiculopathy: A Review. Spine, 1986, 11, 988-991.

[16]McAfee, P., et al, Comparison of Nuclear Magnetic Resonance Imaging and Computed Tomography in the Diagnosis of Upper Cervical Spinal Cord Compression. Spine, 1986, 11, 295-304.

[17]Stokes, I., Bigalow, L., Mouland, M. Measurement of Axial Rotation of Vertebrae in Scoliosis. Spine, 1986, 11, 213-218.

[18]Frymoyer, J., et al, A Comparative Analysis of the Interpretations of Lumbar Spinal Radiographs by Chiropractors and Medical Doctors. Spine, 1986, 11, 1020-1023.

[19]Peindle, R., Engin. A. On the Biomechanics of Human Shoulder Complex-II. Passive Resistive Properties Beyond the Shoulder Complex Sinus. J. Biomech., 1987, 20, 119-134.

[20]Hogfors, C., Sigholm, G., Herberts, P. Biomechanical Model of the Human Shoulder - I Elements. J. Biomech., 1987, 20, 157-166.

[21]Engin, A., Chem., S.-M. Statistical Data Base for the Biomechanical Properties of the Human Shoulder Complex-I: Kinematics of the Shoulder Complex. J. Biomech. Eng., 1986, 108, 215-221.

[22]Engin, A., Chem. S.-M. Statistical Data Base for the Biomechanical Properties of the Human Shoulder Complex - II: Passive Resistive Properties Beyond the Shoulder Complex Sinus. J. Biomech. Eng., 1986, 108, 222.

NOTICE

The NUCCA Board of Directors has decided to make the NUCCA collection of video tapes available to members. The price for tapes has been set at $100.00 per classroom hour. Available titles include:

Osseous Structure Identification (45 min.) ..... $ 90.00
This tape depicts the various bony structures involved in the NUCCA x-ray analysis. Included are structures that present analytical problems. X-rays of live and dry specimens are used.

NUCCA X-ray Analysis (60 min.) $100.00
Step by step procedure of the NUCCA analysis using X-rays of live specimen.

Leg Check and *Headpiece Placement* (45 min.) .... $ 90.00
Leg Check describes the planes of reference and how to align the examiner's body for accurate checking. Models and patient used. Errors are discussed. *Headpiece Placement* briefly describes the biomechanics of the correction of the four basic types. Center of Gravity of the skull and its placement on the three types of headpieces is shown.

Adjusting the A.S.C. (3½ hrs.) $300.00
Step by step procedures used to align the adjustor's body in addressing the various A.S.C.s. Includes the most common errors in each phase. Outline of video follows early *Monographs*, Vol. 1 No. 3 through Vol. 2 No. 4. Film includes various steps for posterior rotations and low vector listings.

Errors in Adjusting the A.S.C. (2 hrs.......... $200.00
Compliments *Adjusting the A.S.C.* This tape describes errors in adjusting, what causes them, and how to correct them.

BASF video tapes have been used for reproduction, which carry a lifetime guarantee. Please specify BETA or VHS. Allow 4-6 weeks for delivery. Prices are subject to change with cost of reproduction.

Some Biomechanical Aspects of Chiropractic

By Ralph R. Gregory, D.C.

The continued scientific development of chiropractic necessitates the application to its procedures of the relevant principles of biomechanics. Chiropractic science should be a body of objective and tested knowledge of the vertebral subluxation and its consequent effects on the human body, and the correction of the vertebral subluxation by the use of force (adjustment) and the effects on the human body resulting from such vertebral correction. A vertebral subluxation is the misalignment of a vertebra, or vertebrae, capable of causing neurological detriment sufficient to produce harmful effects. An adjustment is the correction of the vertebral misalignment factors to remove the neurological insult.

These definitions encompass the practice of orthodox chiropractic. They suggest that chiropractic science should be founded and aided by other related sciences that deal with measurement, force, and the like. These definitions also indicate the need for complete accuracy in the analysis of subluxations and for precision in obtaining the corrections because, lacking these elements, the quality of being factual is lost. Biomechanics can be very supportive of the scientific development of a chiropractic science.

Biomechanics can be defined in several ways. "Bio" is a prefix meaning "life" or "living matter".[1] Mechanics is the "science that deals with the action of forces on bodies and with motion".[2] In brief, Biomechanics is that branch of Physics known as mechanics applied to living bodies. A better definition of Biomechanics for chiropractors would seem to be that of LeVeau (1984) who defined Biomechanics as "The study of forces and the effects of forces on and within the human body".[3] LeVeau's definition seems most adequate because forces producing the subluxation, both internal and external, their effects on the body, the adjustic forces of correction, and the effects of force correction on the body are measurable entities that can help establish the objective body of tested knowledge.

Force is the capacity to do work; it is power made operative against resistance — the transfer of energy from one system to another, especially the transfer of energy to a body by the application of a force. Conceived as a physical property, force is energy.

Many force systems are applied in chiropractic, and in other healing arts, on the spinal column. One most currently popular is manipulation. The value and effectiveness of these force systems should be gauged by their immediate effect on the joint structure receiving the applied force.

The chiropractic adjustment is a mechanical force that transfers energy from the adjuster to the patient's subluxation. An adjustment is a force system that differs from other force systems applied to the human spinal column in that it is calculated to restore misaligned vertebrae to their normal positions, thereby achieving a predetermined objective. Predicting the final result of an adjustment makes the adjustment a scientific procedure.

Vertebrae are constructed so that they belong in an orderly relationship. When in their normal position, they fit together because of their architecture — their unique design and structure. Any force system that is applied to them that is not designed to match them, or increases their misalignment one with another, causes greater malfunction, increased subluxation, and increased damage. If this were not the case, there would be no logical reason for chiropractic. To argue otherwise is a paralogism. Neither would there be any reasonable basis for trying to establish scientifically the effects of a force system on the human spinal column. A position of Biomechanical normalcy is the objective of any force system and it must result from the force system utilized by the chiropractor.

This is particularly true of the Occipital-Atlanto-Axial spine. C0, C1, and C2 provide the greatest challenge to the user of a force system because of the misalignment combinations in different planes found in this area of the spine, the skill required in the force system in producing a biomechanically required consequence, and the precision in analyzing the upper cervical subluxation. Force systems used in the spinal column subjacent to the cervical spine require little skill because the vertebrae possess built-in pathways so that a force that may be somewhat misdirected will tend to move a misaligned vertebra to its normal position.

Furthermore, neurological insult in the Occipital-Atlanto-Axial spine occurs on the central nervous system. A subluxation in this area detrimentally influences all levels of the nervous system. Any attempt to correct a thoracic or lumbar vertebral misalignment is not effective because C0, C1, and C2 must be corrected first if a normal neurological expression is to reach these spinal areas.

Force is power made operative against resistance. A C1 subluxation has several resistances depending on its basic type and the leverage system involved. Some of these resistances are: The distance that the cervical spine has angulated into one of the two frontal planes of the body; the size of the superior articulating surfaces of C2; the position of the skull in relation to the vertical axis; the degree(s) that the cervical spine (and frequently the dorsals) have rotated into the transverse plane, and the amount of C2 rotation into the transverse plane. These resistances constitute the magnitude of power required in the force system in order to reestablish a normal biomechanical state to the spinal column.

At the present time at least, it is not possible to compute the amount of force-power required to correct a given C1 subluxation prior to the adjustment within the limits of safety. If, for example, a C1 subluxation requires ten pounds of force to overcome its resistances, and less force is delivered in the adjustment, it could not result in a biomechanical correction; some of the misalignment factors would still be present after the adjustment. A greater force than ten pounds would produce a change in the basic types, converting a type one, for example, into a type two or four. Such a change in basic types could be injurious and produce future problems because other misalignments could exist or the same ones produce a different neurological insult. Not only could an exacerbated biomechanical state be produced, but patient progress symptomatically be worsened. While precise direction in the delivery of the force system is an essential element, control of the amount of force-power is indispensible. Both elements in the adjustic force system are imperative in obtaining a predictable biomechanical consequence.

Depth and acceleration add two more elements to the adjustic force system that require control. Too great a depth can be injurious to soft tissue, produce vascular harm, and change the relative position of adjacent osseous structures, such as the skull. Too rapid an acceleration is detrimental because each C1 subluxation has its peculiar rate of speed depending upon the distances each involved structure must move in relation to others in the different planes in order to achieve a biomechanical normalcy.

NUCCRA developed the adjustment known as the triceps pull adjustment which was designed to resolve not only the problem of the exact amount of force to correct any given subluxation but the problems of depth and acceleration. In the triceps pull adjustic force system, the adjuster builds within his own body by pulling his triceps the exact amount of force required to overcome the resistances of the subluxation he is addressing. By pulling his/her triceps equally, the shoulder girdle is compressed and the force built and retained until it is sufficient to overcome the resistances of the subluxation. At that moment when the shoulder compression force equals the subluxation's resistances, or slightly exceeds them, the C1 subluxation moves freely with control of depth and acceleration.

Stated another way, the adjuster exercises functional reversibility of his triceps. That is, he/she reverses the normal action of the triceps, pulling or contracting these muscles which action compresses the shoulder girdle bilaterally. In compressing the shoulder girdle, power is built to the point where it is sufficient to overcome the resistance. At the moment that the power equals the resistance, there is no more need for it because the vertebrae have moved. The shoulder lever, which is the largest lever, moves first which it should do. This is a first-class lever: The triceps are the effort, the shoulder joints, the fulcra, and the shoulder girdle is the resistance. The all-important element of the correct direction of the force determines the alignment of the vertebrae.

Force that is applied in the adjustic force system along an incorrect path or improper direction increases resistance. If a subluxation is difficult to move, the line of drive has usually been misfigured, or the adjuster's alignment to the correct line of drive is wrong. The adjuster's episternal notch and pisiform bone must be coplaner with the final line of drive, or resultant.

All of this is simple biomechanics. Vertebrae are constructed so that they exist in juxtaposition one with the other. They have a normal position determined by their architecture, and are not interchangeable. They must, therefore, be aligned to perform their functions. To apply to them a mechanical force that moves them to any position other than normal causes impairment of function, more damage, more subluxation, greater neurological insult, and more symptomatic signs.

What is required from the delivery of an adjustic force system to enable it to restore a normal electro-chemical neurological flow throughout the nervous system? If a vertebral subluxation is caused by the misalignment(s) of the vertebra(e), subluxation correction can only be accomplished by a re-alignment of the misalignment factors of the vertebra(e) causing the subluxation. There are several force-systems applied by chiropractors to vertebral segments. But the question that must be answered by the profession is: Do these force-systems establish a normal biomechanical state in the spinal column?

The establishment of a state of biomechanical stability by the force-system is paramount in assessing patient progress. It is more reliable than symptoms because symptoms are dependent upon sensory imput. Important as symptoms are, they are variables. They can lessen with increased neurological insult and increase for a short period of time with a reduction in neurological imbalance. Symptoms cannot be safely relied upon as an indication of when to adjust. An increased subluxation may bring symptomatic relief but the duration will be short before a greater symptomatic picture will develop.

Bodily distortion is the only sure indication — the only positive symptomatic evidence — of a C1 subluxation because it is measurable. It is the first objective sign of a C1 subluxation. The twisted pelvic girdle, the spine that is deviated from the body's vertical axis, the contractured leg, are positive, measurable evidence that a C1 subluxation exists. These signs indicate neurological imbalance in the patient's central nervous system, and have a reciprocal and functional relationship to the C1 subluxation. These signs are measurable before and after the introduction of the adjustic force-system, and their alleviation over a period of several days indicate the establishment of an improved biomechanical state.

References

[1]Random House Dictionary, 1980.

[2]American Heritage Dictionary, 1970.

[3]Le Veau, B.F.; A summary of perspectives, Phy. Ther., 64, 1984.

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NUCCA Doctor Observes Fifty Years in Chiropractic

Dr. L. D. Vinson of Gadsden, Alabama completed fifty years in the practice of chiropractic this year. He continues his practice.

A 1937 graduate of the Palmer College of Chiropractic, Dr. Vinson began practice in a small town in Alabama near his home town. After three years of practice there, he moved to Gadsden where he has practiced for forty-seven years continuously.

In 1942 Dr. Vinson and Opha Stewart were married. The union resulted in two sons, the eldest an attorney and the second an Episcopal minister; and a daughter, a homemaker.

About 1949, Dr. Vinson became interested in the Grostic system of Upper Cervical through contact with Dr. Earl Striplin, one of the original practitioners of the Grostic system. Enthused with this method of practice, Dr. Vinson pursued the study and research taught in Ann Arbor, Michigan, and after the untimely death of Dr. Grostic in 1964, he came to Monroe, Michigan where he continued with NUCCA.

Dr. Vinson is a valued member and practitioner of NUCCA Upper Cervical techniques, and has been a supporter of NUCCRA research. He is a sincere friend to all the doctors with whom he associates and liked and respected by all. May he be blessed with many more productive years.

Donation to NUCCRA from Fair Estate

A check in the amount of $6,000.00 dollars was recently received by NUCCRA from the estate of Dr. Helen Fair of Dallas, Texas. The money was donated to help finance the research being conducted by NUCCRA.

Dr. Fair, a member of the National Upper Cervical Chiropractic Association, Inc. (NUCCA) for many years, was familiar with the research work of the National Upper Cervical Chiropractic Research Association (NUCCRA). She attended NUCCA Conventions and seminars and will be sadly missed by her many friends and colleagues.

Chiropractic Adjustment Force Transmission Mechanics

EDITOR: This paper was submitted to the MONOGRAPH by Dr. C. Dwain Ingram, Nanaimo, British Columbia, Canada, and is published as received. The contents do not necessarily reflect the views of the National Upper Cervical Chiropractic Research Association, Inc. (NUCCRA)

By R. E. Blaby

When asked one day to find if there is a way to mechanise a Chiropractic adjustment, my immediate reply was to question as to the mechanics involved in the transmission of force in the body to the bone.

This I found had to be answered in theory by myself. An upper cervical modern adjustment is hardly felt by the patient and the bone is moved. I have first hand experience as a patient. The adjuster forms a triangle through his two arms and the shoulder girdle, with the hands locked together in the roll-in phase with the pisiform contacting the transverse process. Then performing the triceps pull to overcome the shoulder girdle resistance. The result of this is a force introduced to the contact area which only deforms the patient's skin by about 1/8". Under these circumstances the mechanism of force transmission from the point of application to the patient's upper cervical bone appears to casual observation to be a little hazy. See fig. 1.

So what we will look at will be applied principles that can clear up this haze. Then as we progress to more realistic mechanics we will complicate what was a straight forward explanation.

Recent tests performed by applying the adjusting force to a force transducer, shows as much as 20 lbs. peak force can be transmitted through a 1½" thick piece of tender beef with no more than 1/8" deflection at the surface.

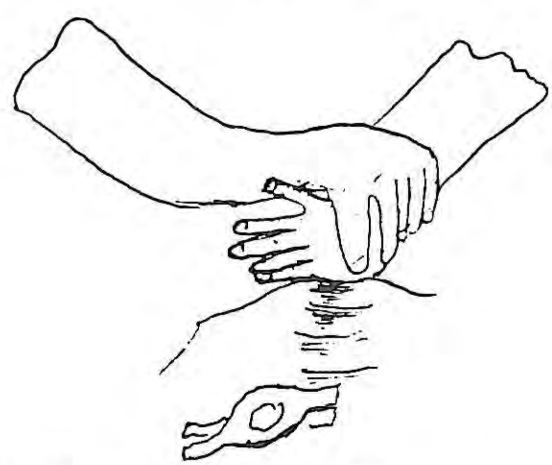


Fig 1 Upper Cervical Adjustment Force Transmission.

If we apply a short stroke of force over a very short period of time to a fluid, the inertia of the immediate fluid to be displaced will cause localized fluid compression. Note:

Liquids are considered as incompressible, however we all know that all materials are compressible, some better than others. This compressed fluid will quickly re-expand to over come the inertia of the next fluid layer. The force can not expand back to the point of application because the force is still being applied at that moment. By this means, the force is carried in transmitted waves until striking a higher dense mass such as bone which will absorb the force with a frictional movement.

Due to the harder bone material, the force not absorbed in frictional energy will rebound as a wave. The reduced energy wave will be reflected to the adjuster, but in an out of phase state due to the bone displacement. If the bone does not shift, then the direction of the wave missed, and was dissipated, or alternatively will strike the bone without a frictional shift and be rebounded in the same phase as the transmission. A reflected wave will in or out of phase will have a reduced amplitude.

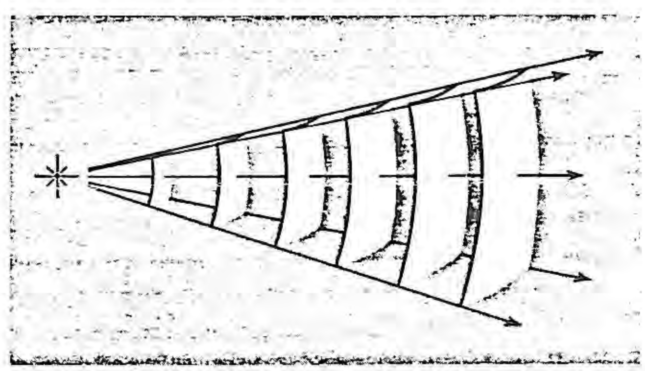


Fig. 2. A spherical wave. The rays are radial and the wavefronts, spaced a wavelength apart, form spherical shells. Far out from the source, however, small portions of the wavefronts become nearly plane.

All transmitted waves are by nature distortional, ie. they expand perpendicular to the direction of propagation. Consequently the field of force expands reducing the force per unit of area. Under these circumstances the force doing useful work on the bone can be less than the applied force, see fig. 2.

A force may be transmitted through a bone to body tissue if the application is directly to the bone and the bone is elastically moved a fraction to transmit a pulse. For example the skull.

The above sounds straightforward in its over simplicity, however in practice the theory is not that simple.

As waves travel through a medium they alter both the stress magnitude and the relative velocity of the individual particles composing the medium. Plane waves are defined as dilational if they produce particle motion along the direction of propagation, or distortional if particle motion is perpendicular to the direction of propagation.

Longitudal waves transmit energy along the direction of propagation. The velocity of propagation is somewhat dependent upon the frequency, however the relatively low frequency of waves induced in a manipulation would be a uniform velocity to the following:—

$$C = (E/p)^{1/2}$$

Where C = Wave propagation velocity.
E = Youngs modulus.
P = Plastic stress, assumed independent of strain.

Torsional waves transmitting shear stresses are encountered typically in rapidly applied motions on helical type springs and in rotory transmission.

Torsional waves propagate at a velocity to the following:—

$$C = (G/p)^{1/2}$$

Where G = Shear modulus.

Super Position Principle

Two or more waves can travel independently of each other. The waves can be completely different in or out of phase. At some common nodes the transmitted forces can reinforce each other. At other points the forces can be greatly reduced due to negative interference.

Two basic conditions exist.

ie. Waves of major amplitude travelling independently, or true superposition where the major wave act as a carrier for a smaller amplitude wave. The reason for this explanation is some of the inexplicable complications of force transmission are rooted in the superposition phenomena. See figs. 3-6.

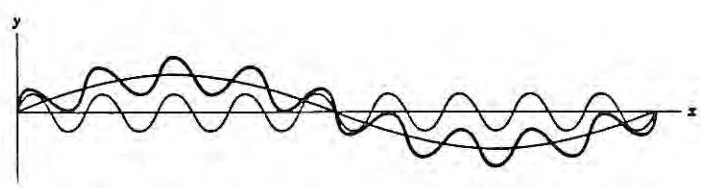


Fig. 3. The addition (heavy line) of two waves of widely differing frequency (light lines).

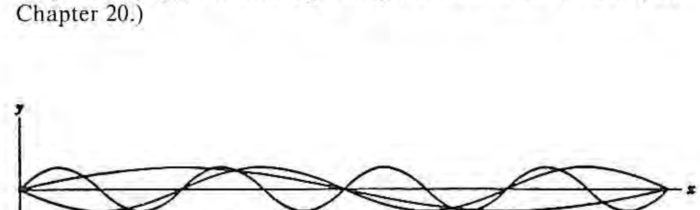


Fig. 4. The addition (bottom) of two waves with nearly the same frequency (top), illustrating the phenomenon of beats. (See Chapter 20.)

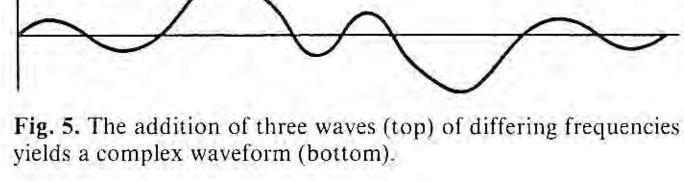


Fig. 5. The addition of three waves (top) of differing frequencies yields a complex waveform (bottom).

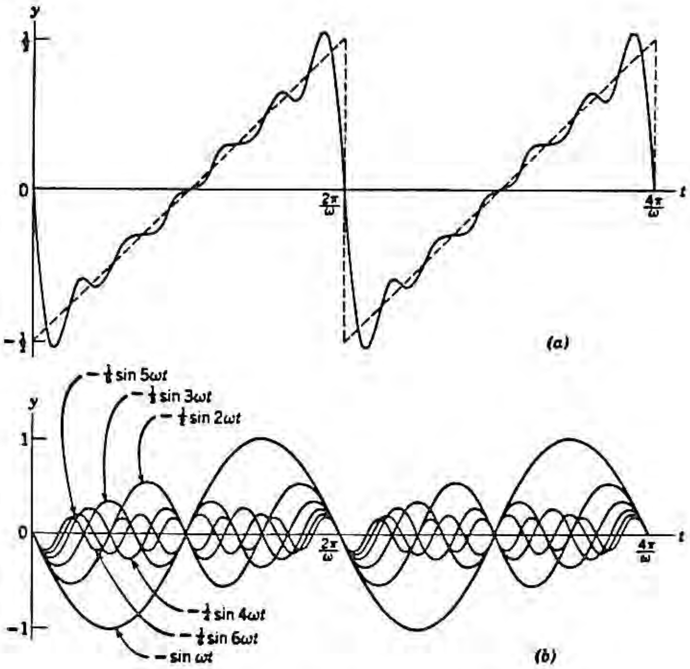


Fig. 6

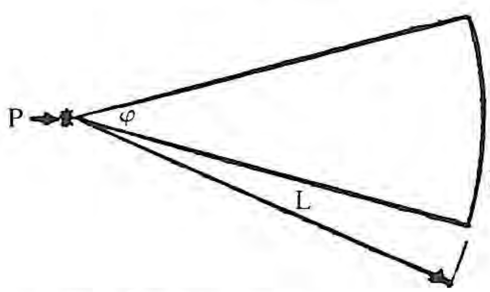
Power

Power transmitted by a force wave is the average power of one half cycle. Rate of transfer of the energy depends upon the square of the amplitude and frequency. This only applies to a perfect single wave.

If the medium that is being transmitted through deviates from the elastic limit, the above wave characteristics can not apply. The body is a complicated transmission medium. We can assume that the body in response to small displacement waves acts like a liquid containing solid structures of bone.

As previously mentioned a single wave transmitting a force usually propagates in the form of a cone, ie. the expanding wave front will cause the transmitted force to the receiving area to be in proportion to the ratio of the wave front to the receiving area.

The force in respect to the wave front area is:—



$P = \pi I (LT\ an\mu/2)^2$

Where P = Applied force.

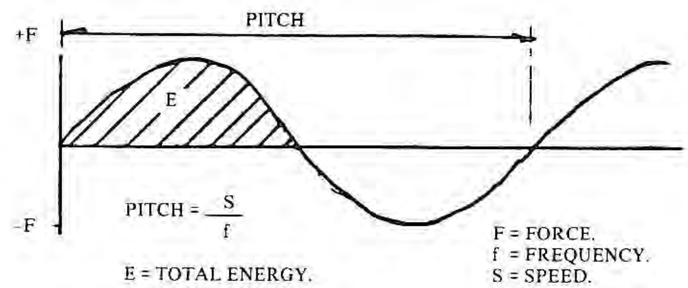
φ = Cone angle.

L= Distance.

I = Intensity per square unit.

$I = P/\pi (LTan\varphi/2)^2$

A typical pure sine wave is as shown:—



Pitch = s/F

F = Force amplitude.
f = Frequency.
s = Speed of propagation.
E = Energy transmitted.

The following information is to attempt to visualize what mechanics are involved in transmitting forces in a living body. The flesh is made up of tissue, muscle, and sinew which cannot be as simple for wave propagation as we would like to believe. If the flesh was a uniform substance the above theories would be ideal for turning individual judgement into a science.

To give some appreciation of the nature of force transmission in a body we would have to look at the transmission properties of materials which vary from semi-solid to semi-liquid. The subject is known as Rheology.

The perfect wave of force we have been looking at are known in the rheological language as "Hookian" waves. These are waves transmitted through solid bodies and the particles of the body are deformed within the elastic limit of the material. In a fluid body a perfect wave is known as "Newtonian" waves. These are transmitted in a uniform liquid with relatively large particle movements.

There is an intermediate state known as a state of Rheology. This is where a body is not entirely liquid and not entirely elastic.

Basic intrinsic properties are:—

- Elasticity.
- Viscosity.
- Plasticity. (Internal solid friction.)

These can be combined into:—

- Firmo viscosity.
- Elastico viscosity.
- Plastic viscosity.

Other properties are:—

- Elastic fore-effect.
- Elastic After-effect.

Technical properties are those for which a method of measurement has been devised. Some of these measured values are in a form of a relativity index.

Examples are:—
- Penetration.
- Ductility (ie. internal friction, plasticity).
- Tack. (Viscosity and yield stress).
- Yield stress.
- Thixotropy. (Not solid but impedance to flow).

Pure elasticity is according to the Hookian theory. In addition we have the Newtonian behavior of viscous fluids. The human body is a combination of these states known as the kelvin state, which can be approximately described by the analogy of a sponge of solid springy material soaked with fluid.

Then there is the Maxwellian state of a spring acting on a newtonian fluid.

The illustration of plastic flow is the Saint-Venout solid, ie. a spring force acting on a friction load. See examples of simulated forces, figs. 7-10.

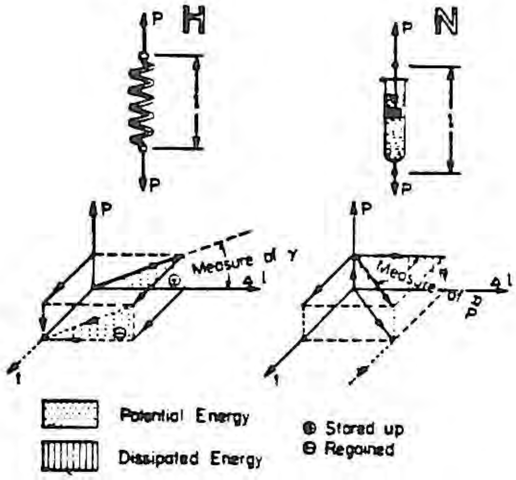


Fig. 7. Model of Hooke-solid and Newtonian liquid.

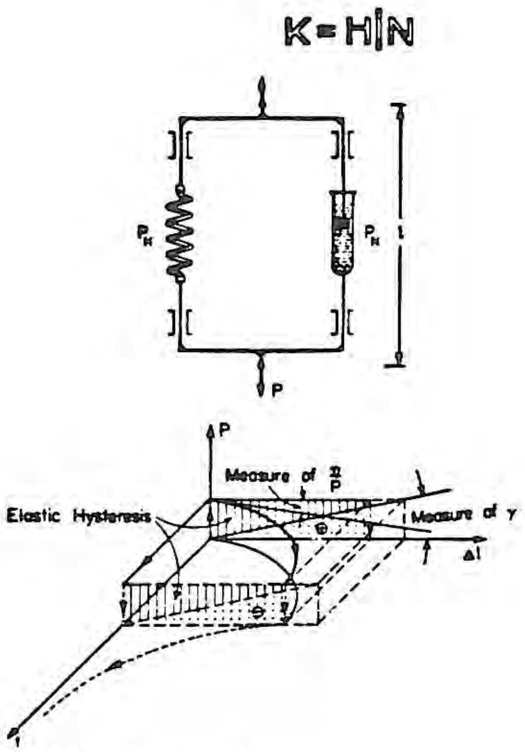


Fig. 8. Model for Kelvin solid $P = P_H + P_N$.

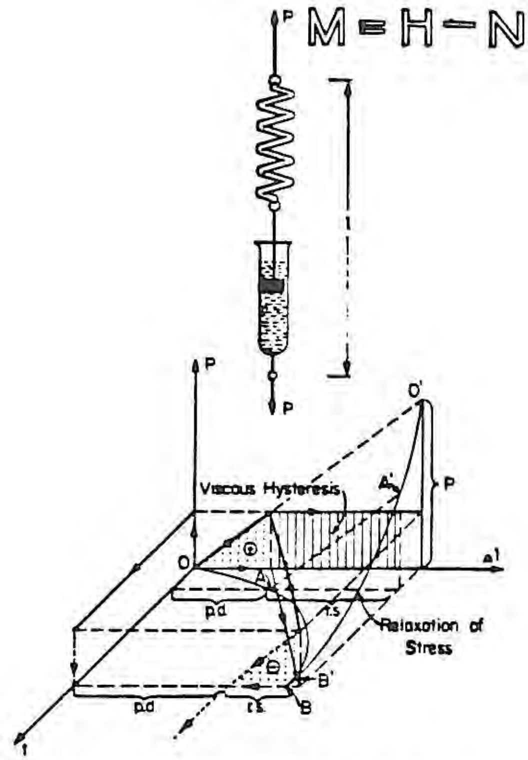


Fig. 9. Model for Maxwell liquid $+l = +l_H + +l_N$.
p.d. = permanent deformation
r.s. = recovered strain

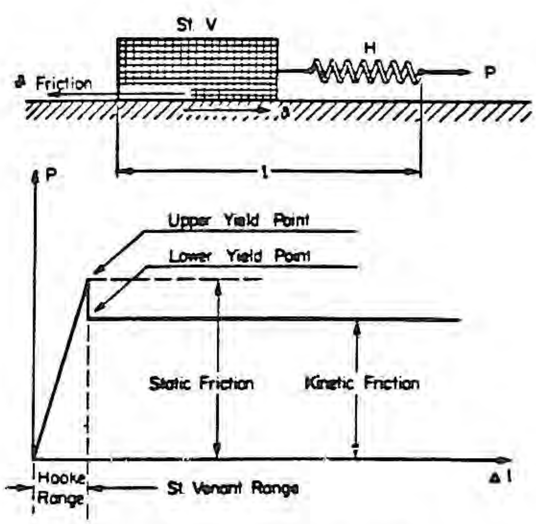


Fig. 10. Model for Saint Venant plastic solid.

Damping and internal friction can attenuate force transmission considerably, unless the application is rapid enough to send a compression wave of a frequency which would not be affected by the natural frequency of the factors mentioned.

The successful practice of upper cervical applications have been checked for the force time curves. In most cases the force buildup rate is more than 200 milli-seconds. This is too low a frequency for wave generation from the contact area to the bone, so the assumption can be that the wave is generated by the practitioner at the shoulders and transmitted through the arms and pisiform into the patient's body. This would be more reasonable for an expected frequency and speed.

References

Handbook of physics. 2nd. Edition 1958, Magraw Hill, Chap. 3, Rheology by M. Reiner, Israel Institute of Technology.

Mechanical design and systems handbook, Sect. 16, 1964 Edit. McGraw Hill.

Industrial Reology and Reological Structures by H. Green, New York and London 1949.

A Survey of Developments in Reology, App. Mechanics, Revs. 4:202 (1951)

A Survey of General and Applied Rheology, by G. W. Scott Blair 2nd. Edition, London 1949.

Donors to NUCCRA Research

NUCCRA Research has expanded in the search for solutions to many problems regarding the subluxation, its effects, and its correction. Non-chiropractic institutions have become involved with their expertise. Many thousands of dollars have been raised, and more money to finance research is needed.

Contributors wishing to assist may contribute directly to NUCCRA or through the Ruth O. Gregory Memorial Fund. This fund was established by the NUCCA Directive Board after Mrs. Gregory's death in 1982 and is to exist in perpetuity. It is in memory of Ruth O. Gregory, who devoted time, effort, and money so unselfishly to the organizations that chiropractic would become more scientific and of greater benefit to the patient, the practitioner, and the profession.

All contributions are tax deductible.

Listed below are the most recent donators to NUCCRA and the Ruth O. Gregory Memorial Fund. NUCCRA extends its heartfelt thanks to all who have so kindly contributed.

Drs. J. & L. Downes	California
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Dr. L. Vinson	Alabama
Dr. M. Tao	California
Dr. Harry Alexander	Ohio
Dr. Ralph R. Gregory	Michigan

The Twenty-First NUCCA Convention

The 1987 Annual NUCCA Convention and Educational Conference was held at the Howard Johnson's Motor Lodge, Saturday, May 2nd through Tuesday, May 5th. The convention room was filled with doctors and students from the United States and Canada.

Convention Chairman was Dr. Daniel Fedeli from Chicago, Illinois. Dr. Fedeli opened the convention with an inspiring address.

The Educational Conference was supervised by Dr. Daniel C. Seemann, University of Toledo and Executive Director of NUCCA. He was assisted in the "hands on" Program by Drs. Teresa A. Palmer, K. E. Denton, A. A. Berti, Marshall Dickholtz, Sr., Lloyd Pond, Lonnie Pond, Ed Stein, Glenn Cripe, L. Schrock, and R. R. Gregory.

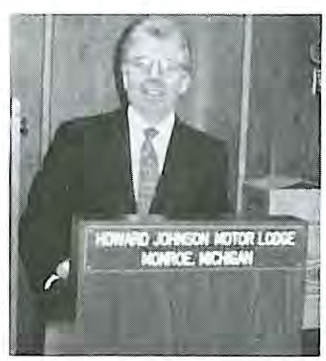
Color-coded participants were rotated from one station to another. Each station had a certified instructor: Film analysis, adjusting technique, patient placement, biomechanics, and leg checking.

Highlights of the Conference were the presentation by Dr. Daniel C. Seemann on the Predominant Factor Theory, and Mr. James Palmer's address on NUCCRA Research. Both are Professors at the University of Toledo and members of the NUCCRA Research Board.

Beginners at the convention were given special instruction in the basic work under the supervision of Dr. Keith E. Denton.

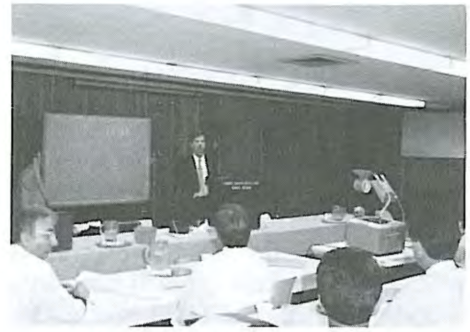
A banquet was hosted by NUCCA on Monday evening, May 3, at which Dr. Lloyd C. Pond of New Mexico was "Roasted".

Dr. Lloyd Pond instructs in NUCCA Convention.



Dr. A. A. Berti lecturing at NUCCA Convention.

Small group attend Biomechanics Class at NUCCA Convention.



James F. Palmer, M.S., addresses the 1987 NUCCA Convention.

Participants attend NUCCA lecture.

Doctors and students at the 1987 NUCCA Convention.

Dr. Daniel C. Seemann presents lecture at NUCCA Convention.

Dr. Daniel Fedeli, Convention Chairman, 1987 NUCCA Convention.

Dr. Lloyd Pond of New Mexico responding to banquet roast.

NUCCA Director Lectures in India

Albert A. Berti, D.C.

Dr. B. J. Palmer once said, "You will never know what little thing you do today will affect millions of people tomorrow." I had the opportunity in the past year to examine and correct the cervical subluxation complex of two directors of the Maharishi World Centre for Perfect Health. As a result of the health benefits experienced by these individuals I was invited to New Delhi, India to present the NUCCA concept of the spinal subluxation complex to a large group of Medical Doctors who were perceived to have some particular expertise relating to the health field. Approximately one hundred and twenty doctors were present representing various health centres throughout France, West Germany, Sweden, Norway, Switzerland, Holland, Australia, Italy, Spain, England and United States.

Although great care was taken to explain the detailed and specialized nature of the equipment necessary to properly evaluate and correct the subluxation complex prior to my arrival in Delhi, the proper equipment was not available at the conference center. This turn of events proved frustrating since twenty hours of lectures and demonstrations including examining, evaluating and correcting the subluxation complex of ten to fifteen appointed patients.

Due to the lack of proper equipment the NUCCA system of x-ray analysis and adjustments were not demonstrated. A redeeming quality of this adventure was the six hours of lecture on the NUCCA concepts of spinal subluxation complex, spinal biomechanics, neurophysiology of the subluxation, pre and post x-rays and classification of the four basic types. The lecture was enthusiastically received and I was particularly impressed with the depth of the questions asked by the doctors in attendance. As a result of the presentation, NUCCA has been been asked to send a representative to research laboratories in Holland and Switzerland to evaluate different parameters of the cervical subluxation complex. Perhaps this invitation will lead to productive research in the future.

I left the conference earlier than planned. My wife and I had a refreshing visit to Hong Kong on the return trip.

Notice of Price Increase

Due to increased cost of production and increases in postal charges, the educational pamphlets sold by N.U.C.C.A. will be increased from $20.00 per 100 to $27.00 per 100. If pamphlets are purchased at a seminar, the cost will be $25.00 per 100.

N.U.C.C.A.'s status as a non-profit organization requires that pre payment on all items must be received before shipping can occur.

NUCCA Visits Life-West

On January 30th, 31st, and February 1st, 1987, NUCCA presented a seminar at Life-West Chiropractic College at the invitation of the Life-West NUCCA Club and Dr. Charles Hough, College professor. The seminar was well attended by both professionals and students. Representing NUCCA as certified instructors were Drs. Glenn Criple of California, Lloyd Pond of New Mexico, A. A. Berti of British Columbia, Canada. K. E. Denton and R. R. Gregory of Michigan.

Standing: (L to R) Dr. Glenn Cripe, Dr. Lloyd Pond, Dr. Charles Hough.
Kneeling: (L to R) Dr. A. A. Berti, Dr. K. E. Denton.

The 1987 Fall NUCCA Seminar

At its May Board Meeting, the NUCCA Directive Board set the dates for the 1987 Fall NUCCA seminar. The seminar will begin on Saturday, October 31st and end on Wednesday, November 4th at twelve noon.

The Educational program will be under the supervision of Dr. Daniel C. Seemann, University of Toledo, and NUCCA Executive Director. Also coordinating the work will be Mr. James F. Palmer from the University of Toledo and a member of the NUCCRA Research Board.

Instructors will be Dr. K. E. Denton who will be in charge of teaching basics to beginners; Dr. M. Dickholtz, Sr., Dr. Glenn Cripe, and Dr. Lonnie Pond who will teach X-ray analysis; Dr. Teresa Palmer, General instruction; Dr. A. A. Berti, Dr. Lloyd Pond, Dr. L. Schrock, and Dr. Ed Stein, Adjusting Technique, Table Placement, and Leg Checking, and Dr. R. R. Gregory, Biomechanics of the Upper Cervical Spine.

Fees for professionals are $350.00. Doctors in practice for less than two years, $200.00. Students are admitted for $150.00. A deposit of $50.00 must accompany each application form. Recent research findings of NUCCRA will be presented.

All monies above expenses will be used in conducting research.

Further information may be obtained by writing NUCCA, 217 West Second Street, Monroe, Michigan 48161.