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FURTHER SCIENTIFIC LIGHT ON THE HEAD-NECK RELATIONSHIP

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The head-neck relationship has long been a focus of major interest to practitioners of the Alexander Technique (AT). F. M. Alexander, the originator of the AT, became so convinced of its importance that he referred to it as the "primary control" of the whole of what he termed the human "psychophysical mechanism".

The proper functioning of the head-neck relationship remains a central concern in the present-day AT approach and is seen as playing a key role in mediating posture, balance and overall neuromuscular functioning. A significant degree of scientific support for this view can be found in the studies on the postural reflexes carried out by Magnus and Sherrington in the early decades of the 20th century and developed in more detail by later authors – a useful summary is available in the collection of papers emerging from the 1992 symposium *The head-neck sensory motor system*[1] .

During the 1990s, Mikael Karlberg and his colleagues in the Departments of Neurosurgery and Oto-Rhino-Laryngology in the University Hospital in Lund, Sweden, published a series of six scientific papers dealing with various aspects of the functioning of the head-neck relationship with a particular emphasis on how it relates to the broad syndrome of "cervical vertigo". A summary paper entitled *The neck and human balance* by Dr Karlberg was published by Lund University in 1996.

There is no reference to the AT in this work by the Lund research team which probably explains why it has not had the visibility it deserves in the AT profession. The present paper provides a short summary of this work and how it relates to the AT. The Lund researchers have subsequently published a number of further studies dealing with other aspects of the head-neck relationship. These will be considered in a follow-up to this paper.

Karlberg's research

Karlberg numbers these papers I-VI in *The neck and human balance* and the same numbering is used here. Two of the papers (I and II) looked at linkages between neck mobility, or restraints on it, and voluntary and involuntary eye movements. Paper III looked at the effects of neck pain on postural performance and paper IV looked at the effects on postural performance when different treatments were used to deal with the neck pain. Paper V assessed the effects of physiotherapy on patients suffering from dizziness or vertigo of suspected cervical origin and Paper VI looked at the use of posturographic analysis to distinguish between cervical vertigo and other conditions presenting similar symptoms. *The neck and human balance* provides a synoptic view of the work described in these papers.[2]

The following brief notes on each of the above papers are written from an AT perspective. The intention is to identify the extent to which the rigorously conducted research work of Karlberg and his colleagues supports, illuminates, or undermines, the key AT tenet of the centrality of the head-neck relationship. An earlier draft of this

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[1] Berthoz et al (1992)
[2] Karlberg (1996)p33

paper was sent to Dr Karlberg who said it provides an acceptable overview of the research and that he had no objection to its publication on the internet. He is not, of course, in any way responsible for the views expressed in the paper or the conclusions drawn in it.

Paper I – Asymmetric optokinetic after-nystagmus induced by active or passive sustained head rotations [3]

This study addressed the question of whether inducing a twist in the neck has an effect on the functioning of the eyes as indicated by changes in the phenomenon known as optokinetic after-nystagmus (OKAN).

Optokinetic nystagmus (OKN) is a normal involuntary or reflex response of the eye. It was first noted by Purkinje in 1825 and has long been known as "train" nystagmus. It occurs when the eye follows an object moving relative to the head such as when looking out from a moving train – hence the name. It has two parts. In the first part, the gaze smoothly tracks the object until the eye has reached the limit of its movement in its socket. The eye then makes a quick movement in the opposite direction – this rapid return of the eye towards its original position is usually referred to as a right-beating or left-beating movement depending on its direction. The first component is cortically mediated; it is similar to what are known as the smooth pursuit movements with which the eye deliberately follows a moving object. The quick return component is reflex or subcortical.

OKAN is a reflexive movement of the eye which occurs after the termination of the OKN induced by an optokinetic stimulus. Abnormal OKAN is one of the indicators of abnormal functioning of the vestibular system. The researchers wished

> *…to ascertain whether asymmetric cervical proprioceptive input from sustained head rotations induces asymmetric orientational information reflected in asymmetric OKAN, analogous with findings for asymmetric vestibular input.*[4]

In less scientific terms, the study was looking at how inducing a twist in the neck might affect the behaviour of the eyes when they were subjected to tests that involved following a moving object.

The researchers already knew that other experiments on human volunteers had shown that when the vestibular system is artificially disturbed this has effects on the behaviour of the eyes as manifested in OKAN. The trials by Karlberg and his colleagues were analogous and were designed to establish whether similar effects occurred when the normal proprioceptive input from the neck was disturbed by keeping it in a deliberately twisted state. The interest for AT practitioners is whether such deliberately induced distortions in the head-neck relationship produce scientifically measurable effects.

Sixteen healthy volunteers took part in the study, eight men and eight women. During the tests, each subject was seated in a chair. The head was surrounded by a 1.8 metre diameter drum, with 10 cm black and white vertical stripes, which could be rotated horizontally around the test subject's head. During the tests, the drum was rotated for 60 seconds. The eye movements during the rotation period and for 60 seconds afterwards were recorded. The subjects performed mental arithmetic during the test and the 60 sec period after it.

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[3] Karlberg and Magnusson (1996)

[4] Ibid.647

As a preliminary to the main asymmetric testing, each subject was tested with the head facing straight ahead in the neutral position. These preliminary tests were designed to show the behaviour of the eyes when the neck was in its normal state with the head looking straight ahead.

During the tests, the subjects either actively held the head at an angle to the straight-ahead or had it passively held at a 70-degree angle to the straight-ahead by means of a rigid custom-built collar and chin support of the type that rests on the shoulders. The eye-ear axis was horizontal and the subject's position was checked before each test began.

Each subject underwent one test with the head actively held in one direction and another with the head passively rotated in the opposite direction. The test order, active and passive neck twists, left and right twists and direction of drum rotation, were randomly assigned to the test subjects.

Test results

The values found for OKAN in the tests with the head facing straight ahead were in accordance with those reported in the scientific literature for healthy subjects. In other words, the test subjects all showed normally functioning eyes.

When the head was passively held in an asymmetric position – the neck twisted and held in the collar - there was a reduction in the intensity of the OKAN beating in the direction opposite to the twist but not in the OKAN beating in the direction of the twist. When the test subjects actively held the head in a asymmetric position, similar results were obtained.

Part of the background to the study was a desire to establish the validity of the clinical assumption that asymmetrical OKAN is evidence of problems in the vestibular system. The study provided evidence that this was not necessarily the case since the artificially induced twist in the neck was, in itself, sufficient to produce an asymmetrical OKAN.

In their discussion of the detailed results, the researchers note:

> *The reduction of OKAN beating in the direction opposite to the head rotation found in the present study is analogous to the reduction in OKAN beating towards the less active side previously found in conjunction with vestibular asymmetry. This suggests that in healthy subjects cervical proprioception affects subcortical OKN…The findings also provide further evidence of convergence of visual, vestibular and neck proprioceptive signals in healthy humans...This supports the controversial assumption that disturbances of neck proprioception may cause dizziness or even vertigo.*[5]

The researchers go on to mention experiments by other research groups in which different types of stimuli were applied to neck muscles. These experiments relied on the fact that when vibration is applied to muscles it stimulates the firing of muscle spindles thus sending signals to the central nervous system that the muscles have lengthened. Using muscle-stimulation of this type it is therefore possible to produce illusions of the head being twisted to the right or left. This work shows that

[5] Ibid.650

> *…vestibular signals and neck proprioceptive signals affect both cognitive cortical functions ('subjective straight-ahead') and subcortical functions (OKAN) in a similar way.*[6]

Karlberg and Magnusson conclude their paper by discussing the fact that:

> *Cervical proprioception also influences postural control in healthy subjects, the position of the head determining the direction of body sway induced by galvanic stimulation of the vestibular nerves. With the head facing forward, a galvanic stimulus induces lateral body-sway, but if the body is rotated to one side the stimulus induces body sway in the antero-posterior direction instead. As the vestibular stimulus is identical in the two conditions, the changed direction of sway must be due to some signalling of head position interacting with the vestibular signal.*[7]

The detailed findings are complex but the broad sense that postural control and at least some aspects of eye behaviour are influenced by distortions induced into the combined actions of the vestibular system and neck proprioception is clear. This is particularly interesting when considered in an AT perspective.

An AT perspective

The main finding of the paper is that subjects experiencing a voluntary or an induced twist of the neck, show a distortion of the OKAN similar to that when there is an asymmetry in vestibular functioning. The researchers remark that this suggests a convergence of visual, vestibular and neck proprioceptive signals in healthy humans. This would find ready support from any experienced AT teacher; everyday teaching experience demonstrates that the functioning of the overall neuromusculature tends to be affected in a variety of ways by an actively or passively induced twist of the neck.

This recalls Magnus' work on the postural reflexes which led him to the observation, well-known among AT teachers, that

> *The mechanism as a whole acts in such a way that the head leads and the body follows.* [8]

The Karlberg and Magnusson results help fill in some further neuromuscular details on what happens when the leading role of the head is distorted by inducing a twist in the neck. The muscles throughout the whole neuromusculature, and particularly those in the cervical area are obviously involved in any such distortion but those in the sub-occipital area are worthy of particular attention. This group of muscles, comprising the sub-occipital and small anterior muscles, provides a series of links between the skull and the top two cervical vertebrae and is particularly rich in muscle spindles. Jull et al remark

> *The density of muscle spindles is highest in the suboccipital muscles and, even more specifically, in the deeper sections of these muscles. The average number of muscle spindles found per gram of muscle is: 242 in the obliquus capitis inferior; 190 in the obliquus capitis superior; 98 in the rectus capitis posterior minor; …For comparison, the first lumbrical*

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[6] Ibid.650
[7] Ibid.650
[8] Magnus (1926a)p536

in the hand has 16 and the superficial trapezius muscle has 2 muscle spindles per gram of muscle.[9]

The muscles in the sub-occipital area are thus up to a hundred or more times more sensitive to stretching than those in other parts of the body. Thus, though they can only play a minimum role in moving the head, they possess the necessary neurological characteristics and are positioned to act as extremely sensitive strain gauges in the task of monitoring the muscular state of the head-neck relationship. Their major function is clearly proprioceptive rather than contributing to the task of moving the head; Gray's Anatomy observes:

Obliquus capitis superior and the two recti are probably more important as postural muscles than as prime movers, but this is difficult to confirm by direct observation.[10]

From the AT perspective, their main role appears to be the provision of feedback on the relative positions of the head and neck to the postural control centres in the brainstem. If these muscles happen to be immobilised by, for example, a neck collar the postural control centres in the brainstem, identified by Magnus, are not receiving their normal flows of afferent information. The efferent flows which govern postural and other reflex functions, including the responses of the eyes to movements, are therefore deficient and some impact on balance and other functions is to be expected.

Such speculations are supported by the researchers' discussion of the results of experiments by others on the effects of galvanic stimulation of the vestibular nerves which showed that:

With the head facing forward, a galvanic stimulus induces lateral body sway, but if the head is rotated to one side the stimulus induces body sway in the antero-posterior direction instead. As the vestibular stimulus is identical in the two conditions, the changed direction of sway must be due to some signalling of head position interacting with the vestibular signal.[11]

It needs to be borne in mind in the context of the present paper that the main concern of the AT is with the overall functioning of the neuromusculature rather than the specific body elements usually dealt with by therapeutic interventions. In addressing this, AT teachers place particular emphasis on reducing habitual interference with the working of head-neck relationship to a minimum, thus allowing the neuromusculature and especially the postural reflexes to function more effectively. It is thus encouraging to find that this study clearly identifies the orientation of the head relative to the neck as one of the important contributing elements to the overall functioning of the neuromuscular system in healthy humans.

Paper II – Effects of restrained cervical mobility on voluntary eye movements

This study addressed the relationship between neck-restraint and the functioning of the eyes and how this might be connected with tension headaches. In their introduction, the authors note the suggestion that differences in oculomotor functioning between normal subjects and those with tension headache are due to

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[9] Jull et al (2008)p60
[10] Williams (1995) p813
[11] Karlberg and Magnusson (1996)p650

...pathological cervical proprioception induced by increased tension in the neck muscles. However, as tension headache patients have significantly reduced mobility of the cervical spine as compared to healthy subjects, an alternative interpretation might be that the restriction in neck movement per se contributes to the oculomotor impairment.[12]

The formal aim of the study was

…to ascertain whether restriction of cervical movements per se affects voluntary eye movements; and if so, whether there is a concomitant impairment of postural control.[13]

A total of 11 healthy subjects, 5 males and 6 females, took part in the study. The neck movements of each subject were restricted for 5 consecutive days and nights by means of a rigid polyethylene neck collar and alcoholic beverages were excluded for the duration of the study. The collars were only removed for 10 minutes each day to permit the subjects to take a shower.

In the tests of voluntary eye movements, the subjects were asked to move their eyes between two light-emitting diodes set 20°, 40° and 60° apart. These small quick eye movements are technically termed saccades. In what were termed the smooth pursuit movement tests the subjects were asked to follow a light moving at a constant velocity over 60° of the visual field,

In the tests of postural control, the subjects stood with arms crossed over the chest, with heels together and feet at an angle of 30°. To avoid auditory clues, they wore headphones through which music by Mozart was played. Postural control was evaluated by measuring the forces imposed by the subject’s feet while standing on a force platform.

Body-sway was induced in the subjects by attaching a device which provided a vibratory stimulus to the calf-muscles on both legs with the subjects standing on the force platform. Recordings were made with the subjects’ eyes closed. The tests were carried out on a bare force-platform and one covered with a 5 cm thick mat of foam rubber in order to reduce pressure-receptor information from the soles of the feet.

Posture was also perturbed by transmitting an on-off electric current (galvanic) stimulus to the vestibular nerves through carbon-rubber electrodes attached to the mastoid area of scalp. These tests were carried out with the subjects’ eyes closed. Both antero-posterior and side-to-side sway were computed from the variations in the pressure patterns exerted by the subjects’ feet on the force platform.

A control experiment was also done in which in which the above tests were carried out on six volunteers with and without the neck restraining collars. No differences were found and the researchers concluded that wearing the restricting collar in itself did not have any immediate effect on postural control.[14]

Measurements of voluntary eye-movements, both saccades and pursuit movements, were made on Day 1 and Day 5 of the study with the subjects wearing the neck collars.

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[12] Karlberg et al (1991)p664
[13] Ibid.p664
[14] Ibid.668

Test results

The results for the eye movement tests showed that after five days of neck restriction there was little change in the speed of the 20° voluntary saccades but those of 40° and 60° were significantly slower. The only significant change in the smooth pursuit movement tests was a slight slowing at the maximum speed of movement of the light stimulus.

The measurements of sway showed no significant effect on the subjects' performance when subjected to the vibratory stimulus to the calf, or to the galvanic stimulus to the vestibular nerve applied in the mastoid area. The change in the forces induced when dealing with antero-posterior sway suggested that more energy was required to control the position of the body after 5 days of restricted neck movement.[15]

The researchers summarised their findings as follows:

> *…the present findings suggest that restriction of neck movements per se, without a simultaneous tension syndrome, reduces velocity of voluntary saccades and pursuit eye movements. Although the restriction of neck movements caused an increase in variance in vibration-induced body sway indicating a somewhat increased effort to maintain posture, the effect on postural control was small and compensated for so that response to vestibular or proprioceptive disturbance remained unaffected.*[16]

The effects of wearing the neck collar for five days, as revealed by the study, were thus relatively minor. The mobility of the eyes was reduced to a certain extent but only for the larger saccades and faster pursuit movements. The effect on postural control was also relatively small being confined to a suggestion that there was an increase in the energy required to deal with a vibration-induced back and forth postural sway.

An AT perspective

At first sight, the relatively small effect of five days' constraint of the neck in a rigid collar, is quite surprising. Looking at the overall test in an AT perspective it is clear, however, that the test protocol imposes a uniform pattern of neck immobility in both the controls and the actual tests since the pose adopted by the study subjects, standing with heels together and arms folded across the chest, tends to stabilise the neck and shoulder area. This would tend to mask any difference in postural responsiveness between the controls and those who had worn the collar for five days.

Another factor tending to reduce the impact of a temporary restraint to neck-movement is the high degree of redundancy in the mechanisms involved in tracking moving objects. Being able to track the movements of external objects is so vital to survival that like other important functions it can be performed in various ways if the need arises. The relatively simple eye-mobility tests to which the participants were subjected can be performed to virtually the same standard by the extra-ocular muscles acting without any neck-muscle contribution. It is thus not surprising that the effects on eye mobility of restraining the neck for a period of five weeks were relatively slight. It would require a much longer period of neck restraint, perhaps arising from a long-term neck injury, to establish whether such a reduction in cervical mobility has a long-term effect on eye performance.

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[15] Ibid.667

[16] Ibid.669

This might be established by searching for a correlation between postural control and eye-performance. The view that such a correlation existed was, in fact, widely held among the 19th century ophthalmic pioneers many of whom believed, for example, that stooping, which almost inevitably involves a degree of increased neck tension, was a direct cause of myopia. J. Soelberg Wells, for example, said stooping caused an increased flow of blood to the eyes and an *"...increase in the tension of the fluids within the eye..."*[17] One does not need to believe the detailed aetiology nor to accept the same author's suggestion "*...we should, therefore, always direct myopes to read with the head well thrown back."* [18] But it would be interesting to see if modern data support the idea of a correlation between postural and ophthalmic malfunctioning.

Paper III – Reduced postural control in patients with chronic cervicobrachial pain syndrome[19]

Cervicobrachial pain is the term used for pain in the neck which radiates into the shoulder and upper arm. In the introduction to this paper, the researchers note other research results which indicate that:

> *Patients with neck pain have a poorer ability to reassume the original position of the head after an active head movement, indicating an alteration in neck proprioception; and restrictions of cervical mobility by a cervical collar impairs both postural control and voluntary eye-movements in healthy subjects.*[20] *Thus it appears that cervical input can be impaired in patients with neck pain, and may be accompanied by disturbances in postural control.*[21]

The research covered in this paper was therefore designed to establish whether cervicobrachial pain has a disturbing impact on postural performance. The formal statement of the researchers' aim was

> *...to ascertain whether, as compared to healthy subjects, patients with chronic cervicobrachial pain syndrome have disturbed postural control, as objectively analysed by posturography using vibratory induced body sway and galvanically induced body sway.*[22]

The test subjects were selected from patients attending the Department of Neurosurgery at Lund University Hospital. The patients all had cervicobrachial pain of more than three months duration and were being evaluated for possible surgical treatment. Patients with whiplash or other traumatic injuries were excluded and all were examined by the same neurosurgeon and physiotherapist.

An initial 121 patients were considered of whom 89 were selected as having the symptoms of cervical root compression (CRC) without additional complications; these were known as the CRC group. The remaining 18 patients although they suffered from cervicobrachial pain showed no, or only negligible, signs of CRC and were known as the non-CRC group. The degree of pain experienced was measured on a 100 mm horizontal visual analogue scale (VAS) ranging from "no pain" at one end to "extreme

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[17] Soelberg Wells (1864) p82
[18] Ibid.170
[19] Karlberg, Persson et al (1995)
[20] This refers to the work described in Paper II above which showed that the effects of a neck-collar on postural control were slight but greater in the case of voluntary eye-movements.
[21] Karlberg, Persson et al (1995)241
[22] Ibid.242

pain" at the other. The non-CRC group had significantly higher values for pain intensity measured on the VAS scale and significantly lower values of cervical range of motion than the CRC group. A further 20 healthy subjects were recruited from among the hospital staff as a sex and age matched control group.

The test subjects stood upright and facing ahead on a force table with knees extended, heels together but not touching, feet at an angle of 30° and arms crossed over the chest. They wore earphones that relayed Mozart and had their eyes closed or focused on a mark on the wall 1.5 m away. They were separately tested for vibration-induced and galvanically-induced body sway.

The vibration-induced sway was produced by attaching a vibration device to the calf muscles or to the paraspinal muscles above the seventh cervical vertebra using a neck-collar. The galvanically-produced sway was produced by subjecting the test subjects to an on-off galvanic stimulus applied to the vestibular nerves through carbon-rubber electrodes attached to the mastoid area of the scalp.

Test results

In the tests, the postural control of both the CRC and non-CRC groups was significantly poorer than that of healthy subject. Both groups showed higher sway velocities than the controls under calf and neck-muscle stimulation; they also showed greater variation than the controls in the galvanically-induced body sway tests. Within the test groups no significant difference between the CRC and non-CRC groups was found. Cervicobrachial pain, in itself, rather than the presence or absence of CRC, thus seemed to be the crucial factor in these tests. About 50% of the patients complained of vertigo or dizziness.

The overall conclusions of the researchers was

> *Patients with chronic cervicobrachial pain syndrome have impaired postural control, compared to healthy subjects. The results suggest that cervical lesions such as root compression may impair postural control. Disorders of the neck should be considered when assessing patients complaining of dizziness, vertigo, and balance disturbances.*[23]

An AT perspective

Practising AT teachers would readily concur with these findings and the suggestion that neck disorders should be considered in cases of dizziness, vertigo and balance disturbances. The presence of cervicobrachial pain is inevitably associated with reduced mobility in the head-neck area; in simple terms, people with cervicobrachial pain tend to stiffen their necks. AT experience shows that the effects of a stiffened neck ramify through the neuromuscular system and would be expected to bring about a reduction in postural control under the test conditions.

AT professionals would also be interested in exploring the question of whether the chain of causation might be examined in the reverse direction. From the AT perspective the more usual sequence is that habitual stiffening of the neck, whether as a result of poor posture in front of a computer, misguided exercise routines, habits acquired at an early age, or any of a myriad of other ways of distorting the head-neck relationship, leads to impairment of cervical proprioception which in turn leads to misuse of the cervical musculature which results in chronic cervicobrachial pain and impaired postural control.

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[23] Ibid.248

By addressing the underlying postural malfunctioning especially in the head-neck area, thereby allowing for improved neck-proprioception, AT teachers are frequently able to eliminate both the chronic cervicobrachial pain and the reduced postural control. Subjecting such a process to testing procedures analogous to those used in the present study could provide valuable insights for AT teachers and the wider community concerned with the investigation and treatment of cervicobrachial pain.

Paper IV – Effects of different treatments on postural performance in patients with cervical root compression[24]

This study compared the effects of randomly assigned surgery, physiotherapy and immobilization with a cervical collar on patients suffering from cervical root compression. In the words of the researchers

> *…we used a fairly well-defined neck disorder, that is, cervical root compression, as a "model" to investigate the possible importance of cervical sensory information in postural control. We objectively assessed postural performance with posturography before and after treatment in consecutive patients with MRI-verified cervical root compression, randomly assigned to surgery, physiotherapy, or immobilization with cervical collars.*[25]

The test subjects were drawn from patients with more than three months of cervicobrachial pain who were being assessed for surgical treatment. Patients with whiplash or other traumatic injuries were excluded. Three patients from the initially selected group excluded themselves because of spontaneous subjective improvement. A total of 71 patients entered the trial and were randomly assigned to the three treatment groups: 22 to the surgery group; 24 to the physiotherapy group; and 25 to the cervical collar group. Twenty healthy staff from the hospital were recruited as a sex and age matched control group.

The subjects were tested for postural performance on a force table. Postural sway was induced using vibrating devices attached to the calf and neck muscles and galvanically induced perturbation of the vestibular nerve, as described in the previous papers. The patients were tested before treatment and 14 to 18 weeks after surgery or from the date of the start of physiotherapy or wearing of a surgical collar. The control group was subjected to the same tests.

The surgical interventions used what is called the "anterior cervical decompression and fusion technique" in which a pair of cervical vertebrae, usually C5/6 or C6/7 are fused.[26] A cervical collar was sometimes used post-operatively for one or two days but no physiotherapy was given before the tests of postural control.

Physiotherapy was given in the patients' homes by local physiotherapists with documented experience in dealing with neck and shoulder pain. Each patient had 15 sessions of 30-45 minutes each. The choice of treatments was by the physiotherapists and included ergonometric instructions, heat and cold treatments, manual traction, massage, transcutaneous nerve stimulation, stretching exercises, and resting, all directed towards increasing strength and endurance and restoration of the normal range of motion and function.[27] A total of 22 different physiotherapists were used as the patients

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[24] Persson and Karlberg (1996)
[25] Ibid.440
[26] Ibid.442
[27] Ibid.444

came from different geographical areas. It was thus impossible to use uniform methods but this reflects the reality of physiotherapy treatment options.

The cervical collars were of the shoulder-resting type for use during daytime. A soft collar was worn at night. Patients were supplied with a different collar if they had problems with the one issued to them; this happened in two cases.

Test results

The study involved eleven different tests and three patient groups. This permitted the researchers to make a wide range of detailed comparisons which, for the purpose of the present paper, need only be summarised briefly.

The starting point was that before treatment, the three patient groups all displayed significantly impaired postural performance compared to the control group. All three groups showed some improvements after treatment but the improvements in the surgery group were the most marked. In comparison with the cervical collar group, the surgery group showed improvements in all 11 tests used in the study; in comparison with the physiotherapy group, it showed significantly greater improvements in three of the 11 tests.[28] The surgery group also showed a greater reduction in cervicobrachial pain than the physiotherapy and collar groups.

Comparing the postural performance of the groups with the healthy subjects in the control group the researchers found that postural control was fully restored by the surgery but in the other two groups the level of control remained less than normal. As the researchers said:

> *After surgical treatment there were no significant differences suggesting a normalization of postural control in the surgery group. After treatment, both the physiology group and the cervical collar group still differed significantly in postural control from healthy subjects.* [29]

The patients in the surgery group did not manifest any increase in cervical mobility despite the decrease in cervical pain after surgery. The researchers observed:

> *This is perhaps to be explained by restriction of movement due to the fusion procedure itself, though the surgical fusion of two vertebral bodies does not impair overall cervical range of motion to a measurable extent, as assessed with conventional clinical methods.*[30]

In discussing the possible reasons for the improved postural performance after neck surgery, the researchers speculated that if

> *…cervical pain is reduced by surgery, then cervical muscle tension may also be reduced. This may in turn result in normalization of the proprioceptive signals from the neck muscles and a reduction of the sensory mismatch when proprioceptive signals converge with vestibular and other sensory information in the CNS. Such an interpretation is also in line with proposed explanations for the impaired oculomotor control in patients with tension headache.*[31]

The researchers summed up their results as follows:

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[28] Ibid.447
[29] Ibid.448
[30] Ibid.450
[31] Ibid.451

> *...postural control was improved and cervical pain reduced only in the surgically treated group. The mechanism responsible for the improvement is still obscure. The most probable explanation is that the reduction in cervical pain, by reduced pressure on neural structures or eliminated motion after surgery, induces a chain of events, resulting in reduction in muscular tension and hence a normalization of the proprioceptive input and subsequently improved postural control.*[32]

An AT perspective

The failure of physiotherapy to produce any significant beneficial effect either in postural control or pain[33] is perhaps surprising. Most experienced AT professionals, would, however, testify that this is a common occurrence. Many people, including the present author, who have been suffering from chronic cervicobrachial pain, have found themselves having recourse to the AT only when physiotherapy and other treatments have failed.

On the basis of the tests, fusion of cervical vertebrae clearly provides a reliable pain-reduction option. It brings a certain diminution in the natural flexibility and functionality of the unimpaired neck but because of the high degree of redundancy in the neck mobility mechanisms the actual decline in day-to-day performance, as found by the tests, tends to be slight. The trade-off between any such reduction in neck performance and a cessation or major reduction in the pain is likely to be highly attractive to patients.

The after-treatment tests were carried out 14-18 weeks after the end of treatment. This is clearly long enough to deal with any ephemeral effects but leaves open the possibility of longer-term impacts. The control tests showed that the fusion of cervical vertebrae did not reveal any impairment of postural control when compared with the healthy subjects but, as noted earlier, the test-posture itself involves a certain amount of neck immobilisation in the control subjects, thus tending to mask any effects of the fusion procedure.

The research reported in Papers I and II shows that altered neck proprioception as a result of immobilisation has an impact on eye performance as measured by OKAN. Paper III shows that chronic cervicobrachial pain, which also has an impact on neck mobility, affects postural control and, presumably, eye performance. It is reasonable to hypothesise that cervical fusion would have a similar effect, however slight, on neck proprioception. It would therefore be interesting to know whether there are any long-term effects from the alterations in neck proprioception resulting from cervical fusion.

Paper V – Postural and symptomatic improvement after physiotherapy in patients with dizziness of suspected cervical origin[34]

Vertigo and dizziness often accompany neck pain; this syndrome is commonly referred to as cervical vertigo. Because of the linkages between cervical proprioception and oculomotor and postural control, disturbed cervical proprioceptive input has been suggested as a probable cause of cervical vertigo. The aim of this study was:

[32] Ibid.452
[33] Ibid.445
[34] Karlberg, Magnusson et al (1996)

To ascertain whether, as compared with healthy subjects, the selected patients have disturbed postural control as objectively measured by posturography and to investigate in a randomized, controlled setting the effects of physiotherapy on postural performance and subjective symptoms of neck pain and dizziness/vertigo.[35]

The subjects of this study were patients with recent onset of neck pain and simultaneous complaints of dizziness or vertigo who had been referred to the hospital by local general practitioners. A total of 17 patients, 15 women and 2 men, participated in the study. All suffered from neck pain and some degree of vertigo or balance problems and most also suffered from headaches and nausea. The neck muscles of all the included patients were tender when palpated and 13 of the 17 complained of tension-type headaches.[36]

The patients were randomly divided into two groups; the treatment group had 9 patients and the delayed treatment group had 8 patients. Both groups were subjected to posturographic testing. The treatment group started physiotherapy immediately and the delayed treatment group waited 8 weeks when they were subjected to posturographic testing again and then started physiotherapy. A sex and age matched control group was chosen from the hospital staff.

The patients were treated by two physiotherapists. The treatments were based on an analysis of different functions such as mobility, stability, muscle tension and tone, postural alignment and body awareness. The treatments included soft tissue treatment, stabilization exercises for the trunk and spine, passive and active mobilization, relaxation and home training. Treatment was given over 5-20 weeks and the number of treatments varied from 5 to 23. The treatment regimes were individualized and aimed at reducing cervical discomfort and pain so that the results do not permit a meaningful discussion of the approaches used.[37]

Test results

In the initial stimulus-free trials of postural performance, the patients showed significantly higher body-sway velocities than the controls. Variance in the vibration-induced and galvanically induced sway was also significantly greater in the patients than in the healthy controls. In other words, the postural performance of the patients was significantly poorer than that of the healthy controls before the physiotherapy was carried out.

After physiotherapy, all the study subjects showed an improvement in postural performance when tested while standing on the force table without any artificial perturbation of their balance.[38] The treatment group showed significantly lower values for subjective neck pain and dizziness intensity but not for dizziness frequency. In the delayed treatment group there were significant reductions in dizziness intensity and frequency and a reduction approaching significance in neck pain.

The researchers summarised their main findings as follows

…comparison of the patients after physiotherapy to the group of healthy subjects showed the patients' still to be poorer but not in all tests, and

[35] Ibid.875
[36] Ibid.878
[37] Ibid.878
[38] Ibid.878

the difference between the groups had diminished. Thus physiotherapy improved but did not normalize the patients' postural performance.[39]

In discussing their results, the researchers recommended that the possibility of neck disorders should be included when assessing patients complaining of dizziness, while recognising that other diagnoses are common.

An AT perspective

The conclusions of the research team would face no disagreement from AT professionals. The researchers observed

The performance of patients with dizziness of suspected cervical origin was significantly poorer than that of the healthy controls in the objective tests of postural performance. This indicates that postural control is impaired in these patients and suggests that cervical disorders may affect human balance functions.[40]

This lends substantial support to the AT focus on the head-neck relationship as the key element in postural control and the wider functioning of the human neuromuscular system. Everyday AT teaching experience confirms the linkages between postural performance and the general level of cervical functioning – generally assessed as the degree of freedom, flexibility and overall neuromuscular coordination displayed by the pupil while performing the simple task of sitting into and rising from a chair.

Paper VI – Role of posturographic analysis[41]

This paper is mainly concerned with the use of posturographic analysis, using a force table and artificially induced body sway, for diagnostic purposes. The results showed that using this approach it was possible to distinguish patients suffering from cervical vertigo from healthy subjects and from those suffering from cervical neuritis. This work is of obvious relevance to clinicians dealing with such neck problems but is outside the scope and expertise of present-day AT practitioners and is therefore not considered here.

CONCLUSIONS

There is no lack of anecdotal support by well-qualified observers for the often dramatic effects of AT lessons. John Dewey, the philosopher and educationalist, first encountered the AT when he was fifty-six years old and suffering severe back pains and other ailments. Following some lessons with Alexander, his health improved dramatically and he became an enthusiastic friend and supporter of Alexander up the end of his own life forty years later. Nikolaas Tinbergen devoted half his Noble Prize acceptance speech to praise of the AT.[42] Raymond Dart the paleoanthropologist became interested in the AT in the 1940s when he was working with his severely spastic son and remained a life-long supporter. George Ellett Coghill, the American neurobiologist was close to the end of his life when he came to the AT but he was so impressed with the approach that he wrote an enthusiastic introduction to Alexander's book *The universal constant in living*[43].

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[39] Ibid.881
[40] Ibid.878
[41] Karlberg, Johansson, et al (1995)
[42] Tinbergen (1973)
[43] Alexander (1946)p

The credibility of such witnesses is not in question. The problem is the lack of authoritative explanations of what is happening at a neuromuscular level. The same difficulty arises when considering clinical studies in which the AT has been shown to produce significant benefits. The most recent of these is a study of lower back-pain carried out by Southampton and Bristol Universities and reported in the British Medical Journal in 2008.[44] This showed that a regime of AT lessons produced greater clinical improvements in sufferers from lower back pain compared with massage and exercise.

The absence of a physiological rationale for whatever favourable results are found after AT lessons means that the procedures used in the lessons remain essentially empirical. This leaves more or less undisturbed the inevitable sceptical attribution of the results to placebo effects, under whatever guise they may appear, whether the mobilisation of the natural homeostatic repair mechanisms of the human organism, or the impossible-to-control-for effects of prayer or homeopathy. That said, much of the impact of physiotherapy, especially procedures such as traction and massage, equally remain without any satisfactory neurophysiological explanations.

The great value to the AT of the studies by Karlberg and his associates is that they have been focussed on the head-neck area. Their contribution to a deeper understanding of what is happening in the AT is that they have pried apart some of the effects of the disruption of vestibular and neck proprioceptive signals on the postural mechanisms. Their discussion of how chronic cervicobrachial pain can affect postural control puts the experience of AT professionals into a sound scientific framework.

Such studies provide additional building blocks for the wider theoretical discussion of the role of the head-neck relationship which has been happening within the AT since the time of Magnus and Sherrington. From the viewpoint of AT professionals, studies of this type can only provide a sounder foundation for their work and a greater scientific understanding of the mechanisms at work in delivering its well-attested results. It is also to be hoped that further test programmes can be devised in which some of the insights and assumptions of the AT can be subjected to the same degree of rigorous and quantitative scientific testing displayed in these studies at the University of Lund.

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Note

A detailed discussion by the present author of the work of Magnus and Sherrington in relation to the AT, together with some of its later developments, is available at this link http://www.geraldfoley.co.uk/Towards%20a%20neurophysiology.pdf

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