Survey of Neck Posture amongst Schoolchildren
PhD Theses
Gabor Ormos MD.

Introduction

Chronic musculosceletal disorders may lead to disability which burdens people as well as society (1,2,3). Chronic neck pain caused by degenerative spine disorders is a global, rising problem and its associations with reduced neck muscle strength (NMS) and neck posture abnormalities have been found and published. Therefore to obtain data on neck posture and NMS it was already supposed to be important in the school age, to anticipate the chances and risks of degenerative spine diseases. The degenerative cervical spine disorders cause neck pain and restriction in range of movement, but may also be associated with other symptoms, i.e. headache, vertigo, or radiating pain to the arms or to the dorsal region. Ormos has published papers on the pathomechanism concerning neck muscle disbalance, segmental dysfunction (4-17). Cervical dysfunction is crucial in the pathogenesis of "school headache", which was published in Ormos‘s letter to the editor in a respected foreign journal (18).In the treatment of complications with inflammatory rheumatological diseases dominates the restoration of cervical posture (19). Furthermore in the treatment of whiplash neck injuries caused by traffic accidents, the most important is to restore mobility and muscle strength whicht has been proven by the decrease of pain chemical intermediate materials blood levels the first time in world literature by Ormos (20). To clarify aspects of the neckmuscles in a number of other disorders, such as neurological diseases a specialist who is experienced in manual medicine is needed and therefore such a study is relavent to this dissertation (21). There is a paucity in the literature concerning forward head posture amongst children. The definition of the posture according to Basmajian: „ to be straightened up, the body must compensate the gravity by its inside (intrinsic) mechanism …. keeping the cervical spine by inner mechanism that is practically the function of the muscles”.Therefore the survey had to be expanded from the measurement of neck posture to the examination of motion and musculature. Ormos published examinations on the neck posture measured by auxiliary lines on X-rays, but this is not applicable as children's survey method (22). Ormos made an examination on measuring the mobility of the neck by Mobimet, this method is used at the present examination (23).

There is not Hungarian literature concerning the measurement of cervical muscular strength made on adults, although numerous papers are in the international literature. There are no

publications in the Hungarian literature on the measurement of neck muscle in children. Wheras the international literature has only two publications available, which are concerning children's headache that MRI and EMG methods were used.

From a national health viewpoint; earlier exploration and the development of methods of prevention of neck posture, changes of the mobility and the musculature would be most important here.Two of the main methods of prevention are remedual exercises for muscular strengthtening and sport activities.

Such publications on the effect of different sporting activities and remedial gymnastics for strengthening neck muscle with children, are neither known in Hungarian, nor foreign literature. In this topic Ormos and Pavlik, Ormos and Kis made a preliminary measuring examination in the 3 age groups of school-aged children concerned and furthermore they stidied the cervical muscular strengthtening effect of remedial gymnastics which can be performed at school (24,25).
Sporting activities are a prevention possibility, its effect on neck muscle strength amongst school-aged children was first published in the international literature by Ormos et al (26).

Objectives

- To developemethods for measurement head, neck and shoulder posture amongst schoolchildren.
- To develope methods for measurement of mobility in neck and neck muscle strength amongst schoolchildren.
- To survey the neck posture amongst school children of different age groups, to gain data for the normal database and for the detection of early lesions.
- To establish correlation amongst anthropometric data, head/neck/ shoulder posture, the mobility of the cervical spine and neck muscle strength.
- To develope methods for measurement of deep neck muscle strength which are dominantly responsible for neck posture and its examination amongst school-age children.
- To develope methods for exercises that strengthening neck muscles, which can be performed and measured its effectivenes.

- To measure the effectiveness for neck muscle strength of various sporting activities, including swimming, which is most frequently recommended and the most popular national sport, the football amongst 12 years old children.

Subjects and Methods

Subjects

428, nine, twelve and sixteen year old boys and girls in the same proportion have been surveyed. Furthermore 40 children aged 12, who were active in sports (girl and boy swimmers and boy soccer players) have been surveyed and their data was compared to the data of schoolchildren in the 12 age group. Informed consent was obtained from each child and their parents and approval was also obtained from the local ethical committee.

Methods

1. Anthropometric data included measuring weight and height that were calculated to form the BMI values.

2. To measure neck posture digital photos were taken while the subjects were sitting in "neutral head position" and in a resting, so called "slump", position. The digital photos were evaluated by a computer software program, for 3 angles as follows: craniovertebral angle (CVA) = between the line connecting the tragus and C 7 spinous process and the x-axis, head tilt angle (HTA) = between the line connecting the tragus and the base of the nose and the y-axis, and shoulder angle (SHA) = between the line connecting the acromion and C 7 spinous process and the x-axis.

3. The isometric muscle strength in flexion, extension, left and right lateral-flexion were measured by a strain gauge dynamometer. The device was fixed on one side to the wall and on the other side to the subject's head by a helmet. The subjects were stabilized using a belt on their thighs and held at their shoulders by a physiotherapist, who controlled the procedure in order to make sure only the neck muscles were used. The subjects pulled the dynamometer with their head and always turned in the appropriate direction. The maximal isometric force

“breaking force” was measured in nodding (that meant chin tuck with neck extended), flexion, extension, lateral flexion to the right and to the left. Each motion was performed for 10 seconds, with resting intervals of 20 seconds and was repeated 3 times. The measurements were expressed in Newton, the device’s measuring rate was between 1-250 N, with a minimum rate 1 N. An average of the efforts in each direction was calculated and was summed up to a value of total neck muscle strength.

4. Mobility in degrees was measured by a goniometer constructed as a combination of an inclinometer and a compass. This instrument is able to perform measurements in flexion, extension, lateral flexion and rotation to both side and in nodding. So far nodding had not examined direction, which equals the flexion motion in the atlanto-occipital joint. Each test was repeated three times and the average value was calculated.

5. The descriptive data with the 12 year olds has been analysed for correlation.

6. The data of strength values was evaluated by Cluster analysis for strength categories according to the age-groups and subjects with the 12 year olds, who were found as „weaks” took part in a 25 minutes isometric neck muscle strengthening program. The exercises were performed at schools, two times a week for two months and after that their neck muscle strength was measured.

7.To evaluate the effect of different sport activities on neck muscle strength, the data of forty 12 year old subjects (20 mixed swimmers and 20 boy soccer players) and the data of the 138 children with the 12 year olds , whom were non active with sports have been compared.

Reliability study: The reproducibility of strength and mobility measurements was between 8-15%, based on calculating the coefficients of variation. The significance was calculated by the t and Mann-Wittney tests whereas the correlations by Spearman rho test.

Results

1. Antropometric data

- The subject's weight, height, the calculated BMI values, according to the age and sex: showed a proportional increase with age.
- The neck length and the new neck lordosis index (in the 12 year age group):

- The BMI is correlated to the neck muscle strength, and is inversely proportional to mobility, and the CVA values.
- The neck length measured in the neutral position correlated to the values measured in lordosis and to the body height, whereas was found in negative correlation to the SHA values.
- The body weight was proportional to the muscle strength, whereas was inversely proportional to mobility and to the CVA values.

2. Neck mobility measurement results:

- Between 9 and 12 year olds there was no significant difference, however with the 16 year olds a significantly reduced mobility was found compared to both the 9 and the 12 year olds.
  The mobility in nodding was proportional to the mobility measured in the other directions.
- The mobility was in correlation to the muscle strength, but to a lesser degree.
- The mobility correlated significantly to the SHA values, whileof a lesser extent to the CVA and was inversely proportional with the HTA values.
- The neck mobility values of the 12 year old swimmers was significantly greater than that of the non sporting children from the same age group as well as the other two age groups.

3. Neck posture measurement results:

3. 1. Angles characterising neck posture :

- The CVA values were found between ages 9-16 to be reduced on average of 8 degrees (at neutral position) and 6 degrees (at slump position).
- The SHA values were found in both positions at 13-13 degrees reduced.
- The HTA values were found in the neutral position with 1,6 degrees higher, almost being insignificant, while in the slump position reduction of 4,2 degrees, which was significant.

3.2. Correlations within angles characterising neck posture:

• The CVA, HTA and SHA values correlated to each other in both positions.

• The CVA was proportional to muscle strength, while to a lesser degree to mobility and inversely proportional to the CVA with SHA.

• The SHA is proportional to the HTA and inversely proportional to the CVA.
• The HTA is proportional to the SHA and inversely proportional to the CVA.

4. Neck muscle strength measurement results:

4.1. The comparison of age groups:

• The muscle strength values in different age groups were increasing with age. The total neck muscle strength average value with the 9 year old age group was 96.65 N, with the 12 year old age group 133.4 N, and with the 16 year old group was 141.25 N.

• A slight difference (about 10-10 N) was to be found between the 9 and 12 year old age groups and between the 9 and 16 year olds relatively no difference was found.

• The average total muscle strength values has been calculated by cluster analysis and categories have been distinguished, as “weak”, “medium” and “strong”. This showed that with the 16 (and 12) year olds was higher percentage of “weaks”, than with the 9 year olds, while the "strong" distribution was equal within the age groups.

4.2. Correlations within muscle strength:

• The muscle strength values in different directions correlated to each other.

• The muscle strength highly correlated to body weight and height, such as BMI, on a lower significance level to the neck length.

• The neck muscle strength was found in direct proportion with the CVA, and inversely the SHA, and HTA.

4.3. The impact of gender on muscle strength:

The 9 year old girls’ values are slightly (only 1-2 N-plus) higher than those of the boys, but the 16 year old boys are much stronger (average of 30 N plus) than the girls. So at 16 years of age, in muscle strength the sex differences can also be seen.

5. The effects of neck muscle strengthening exercises at school:

The Cluster analysis based "weak" category's children took part in the strengthening exercise program at their schools, after that the control measurements showed significant improvement in all directions of 2 and 3 times higher values.

6. The effect of sport activity on the neck muscle strength:

• Comparing the data of the 12 year old age group of swimmers and soccer players to the non sporting-controll group, sport activity was quantitatively presented to have a strengthening effect on the neck muscles. The strength of swimmers was nearly three times and of the soccer players nearly double that of the controll group.

• The strength of the swimmers was significantly higher than soccer players.

• Comparing the strength of the sporting and the non sporting group with the same age from the gender point of view: the swimmer girls were slightly stronger than boys, but the difference was not significant. The swimmer girls were twice stronger, than the non sporting girls. The swimmer boys were significantly stronger than the soccer player boys. The neck muscle strength of non sporting boys was around half of the swimmer boys, and two-thirds of the soccer players.

Conclusions

Conclusions according to the antropometric data:

- cervical lordosis is in direct proportion to heigth and neck length,
- subjects with higher BMI values are stronger (in the 12 year age group), but they are less mobile and they have more forward neck posture,

Conclusions according to the measurement of neck posture:

Our results prove that neck posture deteorates with aging, ie the neck becoming more forwarded and the shoulder more protracted between ages 9 and 16 years.

The "good" (the "neutral") neck posture is in correlation:

to mobility,

to neck muscle strength,

to "good" shoulder posture,

The "bad" (protracted) shoulder posture is in correlation:

to neck muscle weakness.

Conclusion according to head posture

The reduction of HTA by 4,2% in -slump position- found after 7 years fits to the results published with adults and fits to the tendency seen in the everyday life, the extended head posture which associated to the forward neck posture. *That faulty posture could be the pathomechanism of upper cervical syndrome.*

Conclusions according to the measurement of neck mobility:

between the children aged 9 and 12 there is no signicant difference in mobility,

the mobility of the 16 year aged is reduced significantly compared to aged 9 and 12.

Conclusions according to the measurement of neck muscle strength:

the neck muscle strength y of the 16 year aged is reduced relatively compared to aged 9 (who are younger 7 years!).

The neck muscle strength was found to be weak especially in nodding. As nodding is performed by the deep neck flexors, which are responsible for holding the head, that explains why the forward head posture becomes more frequent with age.

Conclusions according to the effect of strengthening exercises performed at schools:

Strengthening exercises performed at schools during 8 weeks, 2 times a week resulted 2-3-fold increase in muscle strength, especially of the deep cervical flexors. Thus it has been proven, that muscle strength can be restored in a relatively short period of time.

Conclusions according to the effect of sport activity on the neck muscle strength:

The study showed quantitatively that the regular sport activity, especially swimming strengthen neck muscles. The increase in nodding measured by the triple-value numerically verified the remedial effect of swimming on neck posture. This has not been presented up to now.

The study showed, that sports such as swimming and soccer, which have no direct impact on the neck, has a strengthening effect on neck muscles.

The methods used in the present study offers prospects for measuring the impact of different training techniques, for example of different swimming styles.

From the public health perspective is screening in childhood seems important. On that basis by exercises performed at schools neck posture can be restored. The option for primary prevention is sport activity, of which's impact has been proved by the present study.

References:

1. Ormos G, Vértes P. Mozgásszervi betegek keresőképességének elbírálása 2. Magyar Reumatológia 1982; 23 (3):169-176.

2. Sallai JR, Ormos G. A megváltozott munkaképességű, krónikus mozgásszervi betegséggel élő emberek anyagi helyzete és jövőképe. Rehabilitáció 2009; 19 (1): 22-25.

3. Sallai JR, Bálint G, Ormos G.: Porckorongsérvvel operált betegek posztoperatív állapotának átfogó felmérése Rehabilitáció 2010; 20 (3) 142-145.

4. Ormos G. A csontkovácstól a kézzel gyógyító orvosig. Gyógyfürdőügy 1977;11 (1): 34-35.

5. Ormos G. A cervicalis fejfájás főbb típusai. Rheumatologia, Balneologia, Allergologia 1978; 19 (2):88-92.

6. Ormos G. A csontkovácsok titkai. Budapest: Akkord-Generalpress, 1990.

7. Ormos G. A manuális terápia hatásának vizsgálata cervicalis syndromában. Lege Artis Medicinae. 1991;1(17):1218-1221.

8. Ormos, G. Manuális terápia: gyógyítás műfogásokkal az orvosi gyakorlatban. Budapest: Springer,1992.

9. Ormos G. A „műfogásokkal" gyógyítás irányzatai, a manuális terápia alapfogalmai. Orvosi Hetilap 1993; 134 (35): 1948-9.*(szerkesztőségi levél)*

10. Ormos G. A csigolyaközti kisízületek struktúrájának és funkciójának szerepe lumbalis syndromában. Magyar Reumatológia 1994, 35 (4): 235-238.

11. Ormos G. A manuális medicina alapismeretei. In: Természetes gyógymódok: Komplementer Medicina. Budapest: KuK kiadó, 1999. p.71-90. old.

12. Ormos G. A manuális terápia lényege, indikációi, kontraindikációi. Háziorvos Továbbképző Szemle 1998; 3(6): 333-335.

13. Ormos G. A minőségbiztosítás szempontjai a manuális medicinában. Komplementer Medicina 1998;2(4): 16-20.

14. Ormos G. Manuális medicina. In: Reumatológia. Szerkesztette Gömör Béla. Budapest: Medicina, 2001. p.78-80.

15. Ormos G.: Reply from Troyanovich regarding (*letter to the editor*) from Lewit. J. Manipulative Physiol Ther 2001; 24 (1):67.

16. Ormos G, Gyeney L, Kő I. A manuális diagnosztika és terápia szerepe a cervikális fejfájások kezelésében. Komplementer Medicina 2005; 9 (1-2): 52-57.

17. Boros E, Ormos G. Szédülés a reumatológus szemével: cervicalis vertigo. Háziorvosi Továbbképző Szemle 2007; 12 (10): 677-682.

18. Ormos G. Cervicogenic Headache in Children. (*letter to the editor*) Headache 2003; 43 (6): 693.

19. Bálint P, Apáthy Á, Sági S, Alföldi L, Lipóth L, Várallyay P, Ormos G, Kaposi NP, Banczerowski P, Veres R. „Akkor és most"- nyúltvelői kompressziót okozó, életet veszélyeztető rheumatoid arthritises atlanto-axialis subluxáció műtéti megoldása. Magyar Reumatológia 2009; 50 (2): 109-110.

20. Ormos G, Mehrishi JN, Bakács T.Reduction in high blood tumor necrosis factor-alpha levels after manipulative therapy in 2 cervicogenic headache patients.J Manipulative Physiol Ther. 2009 Sep; 32 (7):586-91.

21. . Baraczka K, Nekam K, Pozsonyi T, Szuts I, Ormos G. Investigation of cytokine (tumor necrosis factor-alpha, interleukin-6, interleukin-10) concentrations in the cerebrospinal fluid of female patients with multiple sclerosis and systemic lupus erythematosus. Eur J Neurol. 2004;11 (1): 37-42.

22. Ormos G. A manuális terápia radiológiai vonatkozásai. A nyaki gerinc funkcionális röntgendiagnosztikája. Osteológiai közlemények. 1994; 2 (1): 14-19.

23. Ormos G, Domján L, Bálint G. A control trial for assessing the effect of manual therapy on cervical spinal mobility. Hung. Rheumatology. 1987; Suppl.77-80.

24. Ormos G, Pavlik G. A gyengült nyakizmok izometriás erősítése, mint a degeneratív gerincelváltozások primer prevenciója. Nyaki izomerő mérési vizsgálatok iskolás gyermekeken. Rehabilitáció 2008;18 (1): 34–37.

25. Ormos, G., Kiss, R.: Neck Posture Measurement amongst Schoolchildren. Biomechanica Hungarica 2010; 3 (1):183-188.

26. Ormos G, Pavlik G, Kiss R. A versenyszerű sport hatása iskoláskorú gyermekek nyaki izomzatára. Sportorvosi Szemle 2010; 3 (51): 95-102.