Evaluation of upright posture effects and user experience of the Swedish Posture Flexi harness

Anna-Lisa Osvalder
Division Design & Human Factors
Department Industrial and Materials Science
Chalmers University of Technology
SE-412 96 GOTHENBURG, Sweden
E-mail: alos@chalmers.se

Abstract: An upright posture positively affect body language and well-being. A body support that reminds how to sit, stand or walk upright could be a valuable tool for posture correction. The purpose of this study was to evaluate upright posture effects and user experience of the Flexi supportive posture harness with eight test subjects (3 males & 4 females, age 25-57 years) during six weeks. Questionnaires and interviews were used as data collection methods. The results showed that the harness was a useful tool for supporting an upright posture and providing awareness of how to position the body when sitting, standing or walking. It gradually every week improved an upright posture by strengthen the back and core muscles. The harness provided symmetrical loadings on the shoulders and upper back, improved shoulder alignment and contributed to increased satisfaction of body language. Comfort and acceptance of the harness increased over time. A recommendation is to state in the instruction manual that the harness should be used a number of times each week for 1-2 hours for at least one month to achieve posture learning effects.

1. Introduction

An upright posture is often said to positively affect body language, mood and well-being (Carney et al., 2010; Huang et al., 2011; Cuddy, 2015). Being aware of always maintaining an upright body posture when walking, standing or sitting can result in a reduction of back and muscular disorders (Muehlhan et al., 2014; Wilkes et al., 2017; Hackford et al., 2018). Upright sitting, compared to a slouched or a forward bended back position can result in more enthusiasm and be a positive mechanism against stress and tiredness (Lin et al, 2006; Caneiro et al., 2010; O'Sullivan et al., 2012; Castanharo et al., 2014). However in daily life activities it is not always easy to straighten up and keep the back upright. For example people with sedentary lifestyles or frequent hours of sitting at work hunching over the computer (Studebaker & Murphy, 2014) can gain back and neck problems due to incorrect postures and too little movements (Haynes & Williams, 2007; Caneiro et al., 2010, O'Sullivan et al., 2010; Mörl and Bardl, 2013; Wang et al., 2014). A body support that reminds you to sit, stand-up or walk upright with shoulders up and backwards could be a valuable preventive tool for posture correction.

About the author: Anna-Lisa Osvalder is professor in Human-Machine Systems, senior lecturer in Ergonomics and has a Ph.D. in injury prevention. She conducts research in physical and cognitive ergonomics, biomechanics, safety systems, user experience and interaction design at Chalmers University of Technology in Gothenburg, Sweden and at Lund Technical University in Lund, Sweden.

The Swedish Posture Flexi is an elastic support harness developed to activate back and shoulder muscles for improved posture. It is a posture corrector with the intention to gradually help the body to improve an upright posture, which strengthens the back and core muscles when used. It can also improve shoulder alignment, which may result in relieved stress, tension and stiffness in the shoulder region. The idea behind the design of Flexi is that it should be worn with a loose fit when an upright posture is achieved, and should tighten only when slouching, and thereby encouraging the user to straighten up.

2. Purpose of the study

The purpose of this research study was to evaluate upright posture effects of the Swedish Posture Flexi harness when used over a longer period of time. Furthermore, the user experience of Flexi, in terms of perceived comfort, usability and ergonomics, was also analysed.

3. Methods

A user study was conducted with 8 participants in the ages of 25 to 52 years, three men and five women. The test group was chosen to include a variety of people with various gender, age, height, weight, body constitution and physical level of activity. All test subjects were working full time as consultants or engineers, mostly with sitting work by the computer, in offices with furniture with good ergonomics features. None of the test subjects had back problems or sedentary life styles; they exercised to various extents from long walking sessions to more intense sport sessions. In Table 1 the individual characteristics is shown for each test subject.

The Flexi support harness (Figure 1) was available in sizes small, medium, large and extra large. The test subjects could try them on and choose a size that fitted them. They also got instructions about how to wear Flexi and how it functions, as well as information about what an upright posture is and its benefits. Each test subjects used the Flexi support 1-3 hours at the time, 3-5 days a week during a period of 6 weeks. At least twice a week they used Flexi during their office work mostly during sitting and standing activities or a mixture of these at the computer desk. The other occasions wearing the harness were mostly when they were out walking or doing housework.

Figure 1 The Swedish Posture Flexi support with wearing instructions and advice

The subjective data collection methods used were questionnaires and interviews. Each week all participants filled in a questionnaire with contradicting words on 10-digit grading scales for subjective estimations on perceived experiences of using Flexi (Table 2). Specifically questions were asked about how Flexi had influenced their upright posture and shoulder alignment and if they felt any effects on back and core muscles. Also how much effort it acquired to sit, walk or stand upright with Flexi. Furthermore, ergonomic features such as symmetrical loading patterns, physical comfort aspects and acceptance were graded.

Table 1 The test subjects and their individual characteristics

No	Gender	Age (yr)	Height (mm)	Weight (kg)	Body constitution	Flexi size	Physical level of activity
1	Male	52	192	98	Heavy	XL	Walking
2	Female	57	170	68	Medium	L	Intense walking
3	Female	29	172	67	Medium	M	Walking/Jogging
4	Male	26	184	78	Large	XL	Work out/Cycling
5	Female	25	165	63	Small/Med	M	Running/Work out
6	Female	49	168	74	Medium	L	Walking/swimming
7	Female	36	181	85	Large	XL	Walking
8	Male	42	184	79	Med/Large	XL	Running/Work out

After the first week all test subjects were interviewed one by one about their initial experience of using the Flexi harness. The questions asked were semi-structured allowing the participants to freely comment on the questions and the interviewer to ask following up questions when suitable. When the test period was ended the test subjects were interviewed again about their perceived progress during the test period and their final experience of using Flexi, as well as their thoughts for future usage.

Table 2 Questions for subjective estimations regarding use of Flexi

Question number	Statements for grading on a scale from 1 (negative) to 10 (positive)
1	Flexi had *little influence/much influence* on my upright posture
2	Flexi had *little influence/much influence* on my shoulder alignment
3	Flexi had *no strengthen effect/much effect* on my back muscles
4	Flexi had *no strengthen effect/much effect* on my core muscles
5	It acquires *much effort/less effort* to sit upright with Flexi
6	It acquires *much effort/less effort* to walk upright with Flexi
7	It acquires *much effort/less effort* to stand upright with Flexi
8	Flexi provided *unsymmetrical/symmetrical* loading pattern on my shoulders and upper back
9	I experienced it *discomfortable/comfortable* to wear Flexi
10	I *did not accept/accepted* to use Flexi
11	I was *not satisfied/satisfied* with my body language when Flexi wasn't used

4. Results

The result from the user study is divided into two parts; first results from questionnaires and then results from interviews. The questionnaire results mainly focus on body posture, physical loading aspects, comfort and acceptance, while the interview results focus on user experience of use and handling of the Flexi support. Since this is a qualitative user study with subjective outcomes, including a sample of people with a variety of physical conditions, no statistic analyses are valid. The result is in general summarised for the entire test group, but when relevant, individual differences are presented.

4. 1 Results from questionnaires – Body posture

In Table 4 the grading score for each tested effect of Flexi is shown, as a mean value for all test subjects after two, four and six weeks. All statements tested showed a pronounced positive effect after three to four weeks, after that the effect was not changed much until the end of the test period, i.e. a steady state was mostly reached after four weeks.

The results showed that all test subjects agreed on that Flexi had influenced their upright posture and shoulder alignment positively each time it was used (questions 1 and 2). They graded that Flexi had influenced shoulder alignment a bit more than the upright posture; this was especially noted for the small and medium sized females. After about three weeks the test subjects felt strengthen effects on back and core muscles which was increased the following weeks (questions 3 and 4). Especially the female test subjects noticed this, while the male subjects with a large body size did not notice that effect so much during the test

period. The effect was a bit more pronounced for back muscles than for core muscles for men, while for females the effect was slightly more equal (Figure 2).

After three to four weeks all test subjects were more conscious about their body posture than in the beginning of the test period (questions 5-7). They graded that it was easier to walk, stand and sit upright with the Flexi support then in the beginning. At that time, they adjusted their posture to upright even those days they did not use Flexi, by using the core muscles more effectively. Also after four weeks the test subjects were in general more satisfied with their body language and posture than earlier (question 11). Regarding individual differences the younger female test subjects were more satisfied already after 2 weeks, while the male test subjects did not stress any obvious difference until the end of test period.

The loading pattern produced by the Flexi harness on the shoulders and upper back was experienced as symmetrical (question 8) nearly all weeks, with a little less symmetry the first and second week. This was especially seen for the smallest and tallest test subjects, while the middle-sized test subjects found the symmetry rather equal the whole test period.

Table 4 Mean value from 8 test subjects regarding use of Flexi during 6 weeks

No.	Statements (from 1 to 10)	Week 2	Week 4	Week 6
1	Flexi had *little influence/much influence* on my upright posture	7.5	8.2	8.5
2	Flexi had *little influence/much influence* on my shoulder alignment	7.0	6.8	7.2
3	Flexi had *no strengthen effect/much effect* on my back muscles	6.8	7.6	7.8
4	Flexi had *no strengthen effect/much effect* on my core muscles	6.2	7.0	7.3
5	It acquires *much effort/little effort* to sit upright with Flexi	5.0	7.6	8.5
6	It acquires *much effort/little effort* to walk upright with Flexi	4.1	6.3	7.9
7	It acquires *much effort/little effort* to stand upright with Flexi	6.2	8.6	9.1
8	Flexi provided *unsymmetrical/symmetrical* loading pattern my shoulders and upper back	8.0	8.1	8.0
9	I experienced it *discomfortable/comfortable* to wear Flexi	3.8	6.2	7.9
10	I *did not accept/accepted* to use Flexi	5.1	7.8	9.0
11	I was *not satisfied/satisfied* with my body language when Flexi wasn't used	6.5	7.1	7.5

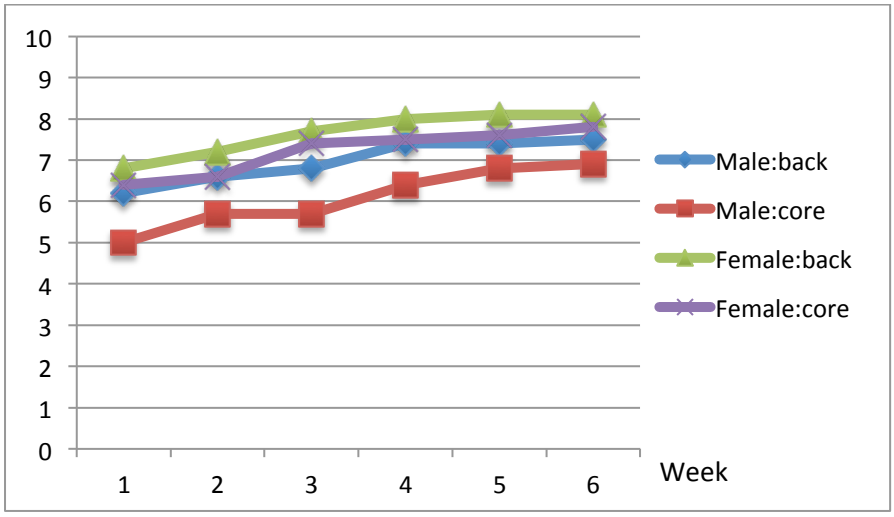

Figure 2 The strengthen effect on core and back muscles for males and females each week

The results showed that physical discomfort (question 9) of the upper body related to wearing the Flexi support was decreased by time (Figure 3). In the beginning it was estimated as un-comfortable to wear Flexi, but after three to four weeks it was considered a bit more comfortable than uncomfortable. In the end of the test period it was estimated as more comfortable and also easier to use and wear Flexi.

Acceptance (question 10) regarding using Flexi increased also every week (Figure 4). Most test subjects scored acceptance higher than comfort every week. Both physical comfort and acceptance increased by time, which is in accordance with that the effort to achieve an upright posture also was decreased by time. The larger test subjects showed a bit lower acceptance and comfort values than the smaller and medium sized people.

Week 1	Uncomfortable	1 2 X 4 5 6 7 8 9 10	Comfortable
Week 2	Uncomfortable	1 2 3 X 5 6 7 8 9 10	Comfortable
Week 3	Uncomfortable	1 2 3 4 5 X 7 8 9 10	Comfortable
Week 4	Uncomfortable	1 2 3 4 5 6 X 8 9 10	Comfortable
Week 5	Uncomfortable	1 2 3 4 5 6 7 X 9 10	Comfortable
Week 6	Uncomfortable	1 2 3 4 5 6 7 X 9 10	Comfortable

Figure 3 Perceived physical discomfort of Flexi per week (mean value from 8 test subjects)

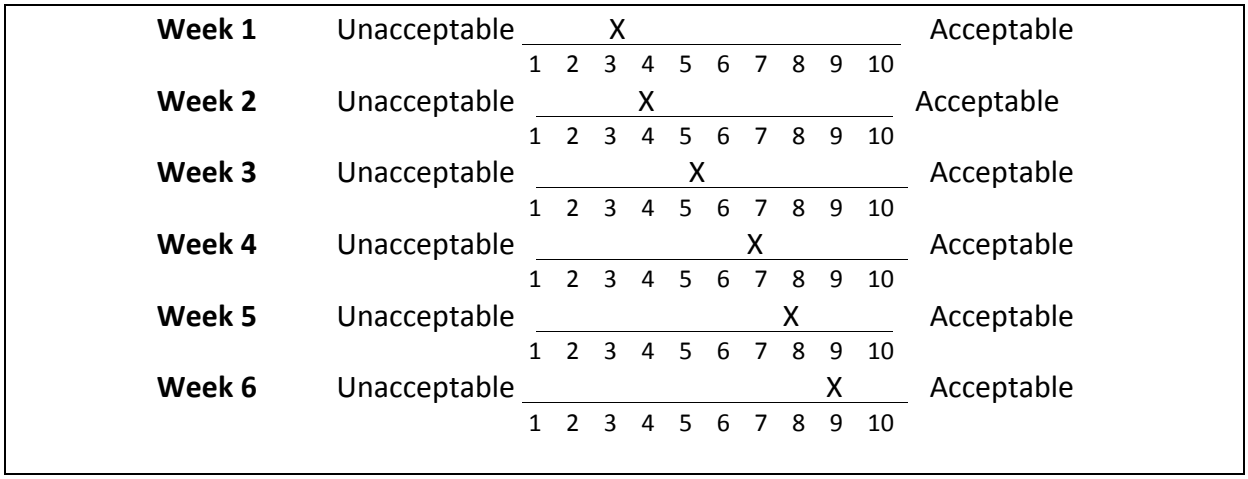

Figure 4 Perceived acceptance of Flexi per week (mean value from 8 test subjects)

4. 2 Results from interviews – User experience

In the initial interview after one week the test subjects' general initial experience of using the Flexi posture support was that it was a bit uncomfortable to wear. More discomfort was experienced when walking than when sitting still working. Some test subjects also stated that it was hard to correct the harness for symmetry and balance when it should be worn with a loose fit at an upright posture. It took some trials to learn how to wear it so it felt comfortable when used correctly. They also said that the first time they used it they took it off after one hour, but the third to fourth time they used the usage time was longer. During the first week the muscles in the back and shoulder area, as well as the abdominal muscles, were stretched more than they used to, and therefore some muscular fatigue occurred.

The test subjects also said that it was a bit problematic to decide and try out which type of clothes they should wear together with the Flexi harness, especially at work. When they used it at home or when they were out walking, they used a simple cotton t-shirt and found that more comfortable than a shirt, blouse, dress or sweater at work.

Some test subjects said that if they had not been participants in the test, they probably had not used the harness any more after some initial trials. This was mostly due to that it was uncomfortable to wear and that it required substantial own activation of the shoulder and core muscles when slouching. They had not understood in the beginning of the test that they needed to straighten up their body much themselves when using Flexi, and this was perceived a bit exhausting. They said that when they took of the Flexi support the first and second time they were much relieved. Furthermore some of them said that they right now (after one week) did not believe in any long time effects regarding increased upright body posture by using Flexi.

In the final interview when test period was ended the test subjects highlighted their perceived positive progress during the test period. They had gain acceptance for the product and the experienced discomfort from the first weeks were much less. It was no problem to adjust the harness for symmetry and balance. Now they were used to the Flexi harness, had learned how to use it, and also learned how to intake an upright posture when sitting,

standing and walking. They also felt that their back, shoulder and core muscles had strengthened a bit, resulting in some relieved tension, stress and stiffness. They had learned that it was much more comfortable to straighten up than to slouch when the Flexi harness was used. They also had noticed that they strengthen up also when they did not use Flexi, but the upright posture does not come unconscious; they said they must actively think of that they should straighten up.

All test subjects were in the end positive regarding using Flexi, but they were not all sure that they should continue using it when the test period was ended. The younger females said that they planned to used it maybe once or twice a week when they sit long hours by the computer or when they are out walking. However they said that they maybe would use it only for shorter periods such as one hour at the time. The males were a bit more hesitant if they should continue.

They also stated that it is important for presumptive future users that they are aware the positive effects that can occur if Flexi is used appropriately during a longer period of time, at least four weeks. Effects regarding upright posture does not come immediately, it requires some individual effort to reach the goal.

All said that the Flexi support had helped them to get increased understanding concerning how a good body posture should be. They were also more satisfied with their body posture after the test period than before, and had noticed some small reduction of the waistline. This was accomplished due to more tension of the torso muscles. A few of the female test subjects (the oldest) had also experienced some muscle soreness during the first two weeks, which they said was a good sign of that they had worked with their muscles in a appropriate way. Also two female test subjects, who often worked long hours by their computer had noticed a decreased muscular tension in the neck and shoulder region. These subjects said that they ought to continue with the Flexi harness every week.

In the end all test subjects indicated that they were satisfied with participating in this study because they had gain insight in the subject and that they in the future will be more aware of their body posture and its importance for body language, mood and well- being.

5. Discussion

The purpose of this user study was to evaluate the effects on body posture of the Flexi harness, covering both subjective grading for quantitative results on physical loading aspects, comfort and acceptance as well as interviews for qualitative results with free comments on experience of use. The sample of test subjects used had a variety in physical conditions, size, weight, age and gender and therefore the results shall be seen as examples of individual person's physical response, impression and experience of using Flexi.

The overall results regarding physical loading showed that usage of Flexi over a period of six weeks gave an positive effect on upright posture and shoulder alignment, as well as an increased strength in the back and core muscles. For the females the change in muscular strength was more pronounced than for the larger and heavier males. This can be explained by that males in general have larger muscular strength and bigger muscles and thereby the rather small changes in muscular tension and posture change caused by Flexi do not affect

them as much. This can also be one reason of why the males were not as positive as the females to use the harness after the test period.

The physical loading results also showed that after about one month the test subjects felt it easier to walk, stand and sit upright with the Flexi support then in the beginning of the test period. This can be due to that the core and back muscles had been loaded in a somewhat different way than normal during a period of time, and thereby increased their strength for upright loads.

All test subjects were after four weeks much aware of their body posture and their body language, even when they did not use the harness. However, the younger females got more awareness already after two weeks, while the males did not stress this change much until the last week of the test period. This shows that it is important to wear the harness for at lest 1-2 hours a day 3-4 times a week during a number of weeks to reach some functional effect, and not only try it a few times and then give up. Therefore the users must be motivated and being aware of that it takes some determination to improve their body posture and reduce muscular disorders, it does not happen of itself without effort. This is for example important to state in the instructions for the harness that it need to be used for a longer period of time for long term effects.

The acceptance of wearing Flexi increased by time but was much linked to physical discomfort issues, for example uncomfortable to wear and that muscular fatigue occurred. In the beginning of the test period both comfort and acceptance was low, but later increased, probably due to that the core and back muscles had strengthen and the test subject had learned how to change their muscular tension for achieving a correct upright posture. The larger test subjects showed a bit lower acceptance and comfort values than the smaller and medium sized people, this can be due to the individual fit and size of the harness. Also acceptance was increased when the test subjects had learned how to adjust the harness for symmetry and balance for correct use, as well as how to activate the shoulder and core muscles when slouching, which was not so easy to perform in the beginning. It was also problematic in the beginning which clothes should be worn together with the harness. All these aspects are initial small problems that can lead to that people give up and do not continue to use the harness. Therefore this is also important to highlight in the instructions, especially how it should be adjusted and worn.

To summarize an upright posture is said to positively affect body language while sitting, standing and walking, which also was shown in this study. The test subjects stated they had learned to straighten up the back and thereby maintaining an upright body posture. The Flexi support had helped them to get increased understanding concerning how a good body posture should be and Flexi was experienced as a useful corrective support that reminds you to keep shoulders up and backwards. Most test subjects said they should continue to use Flexi as a reminder of how to position the body, however not so frequently as in this study.

People are not planned for prolonged sitting or standing still. If we should continue with office work by the computer during eight hours a day, it is much important to be aware of which body postures are used, if they are correct and how they can be improved to increase well-being and minimize the risk for musculoskeletal disorders. A recommendation drawn

from this study is that if using an elastic support harness for activation of the back, core and shoulder muscles this is a useful tool for supporting an upright posture and also for learning how position your body correctly.

6. Conclusions

The overall conclusion of this study was that the Flexi harness is a useful tool for supporting an upright posture and for learning how to position the body correctly when sitting, standing or walking. Comfort and acceptance increase over time and after about one month the harness feels normal and easy to use without any noticeable physical discomfort problems, and without any difficulty to adjust it for symmetry and balance.

The Flexi support has shown the following positive effects on upright posture after continues use of six weeks:

- It gradually improved an upright posture by strengthen the back and core muscles effectively.

- It provided symmetrical loading on the shoulders and upper back, and thereby improved shoulder alignment, which can result in relieved stress, tension and stiffness in the neck and shoulder area.

- It stimulated learning, awareness and understanding of the importance of an upright body posture.

- It motivated conscious adjustment to an upright body posture also when not using the harness.

- It contributed to increased satisfaction of body language and attraction.

A recommendation is that it clearly should be highlighted in the instruction manual how the Flexi harness should be adjusted and worn correctly and that it should be used a number of times each week for 1-2 hours for at least one month for achieving posture learning effects for sitting, standing and walking.

7. References

Caneiro, J.P., O'Sullivan, P., Burnett, A., Barach, A., O'Neil, D., Tveit, O. & Olafsdottir, K. (2010). The influence of different sitting postures on head/neck posture and muscle activity. *Manual Therapy 15 (2019), pp. 54-60.*

Carney, D.R., Cudy, A.J.C & Yap, A.J. (2010). Power Posing: Brief Nonverbal Displays Affect Neuroendocrine Levels and Risk Tolerance*. Psychological Science 21(10), pp. 1363–1368.*

Castanharo, R., Duarte, M. & McGill, S (2014). Corrective sitting strategies: An examination of muscle activity and spinal loading*. Journal of Electromyography and Kinesiology 24(2014), pp. 114-119.*

Cuddy, A.J.C. (2015). Presence: Bringing Your Boldest Self to Your Biggest Challenges. *Orion Publishing Co, London, United Kingdom, 2016.*

Hackford, J., Mackey, A. & Broadbent, E. (2019). The effects of walking posture on affective and physiological states during stress. *Journal of behavioural Therapy and Experimental Psychiatry 62 (2019), pp. 80-87.*

Huang, L., Galinsky, A.D., Gruenfeld, D.H. & Guillory, L.E. (2011). Powerful postures versus powerful roles: which is the proximate correlate of thought and behaviour? *Psychological Science, 22(1), pp.95-102.*

Haynes, S. & Williams, K. (2007). Impact of seating posture on user comfort and typing performance for people with chronic low back pain. *International Journal of Industrial Ergonoimics 38(2008), pp. 35-46.*

Lin, F., Parthasarathy, S., Taylor, S., Pucci, D., Hendrix, R.W. & Makhsous, M. (2006). Effects of different sitting postures on lung capacity, expiratory flow, and lumbar lordosis*. Arch Phys Med Rehabilitation (2006 April), Vol 87(4), pp 504-509.*

Muehlhan, M. Marxen, M. Landsiedel, J., Malberg, H. & Zaunseder, S. (2014). The effect of body posture on cognitive performance: a question of sleep quality. *Frontiers in Human neuroscience, Vol 8(2014), article 171, www.frontiersin.org*

Mörl, F. & Bardl, I. (2013). Lumbar posture and muscular activity while sitting during office work. *. Journal of Electromyography and Kinesiology 23(2013), pp. 362-368.*

O'Sullivan, K., O'Dea, P., Dankaerts, W., O'Sullivan, P., Clifford, A. & O'Sullivan, L. (2010). Neutral lumbar spine siting posture in pain-free subjects. *Manual Therapy 15 (2010), pp 557-561.*

O'Sullivan, K., O'Sallivan, P., O'Sullivan, L. & Dankaerts, W. (2012). What do physiotherapists consider to be the best sitting spinal posture? *Manual Therapy 17(2012), pp. 432-437.*

Studebaker, C.D. & Murphy, B.P. (2014). Prolonged sitting. Current concepts and the physiological effects of seated postures at work. *Professional Safety September 2014, pp. 42-48, www.asse.org*

Wang, H., Weiss, K.J., Haggerty, M.C. & Heath, J.E. (2014). The effect of active sitting on trunk motion*. Journal of Sport and Health Science 3 (2014), pp. 333-337.*