

Assessment of Stresses in the Cervical Spine Caused by Posture and Position of the Head

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ABSTRACT

Preamble. Billions of people are using cell phone devices on the planet, essentially in poor posture. The purpose of this study is to assess the forces incrementally seen by the cervical spine as the head is tilted forward, into worsening posture. This data is also necessary for cervical spine surgeons to understand in the reconstruction of the neck.

MATERIALS AND METHODS

A model of the cervical spine was created with realistic values in Cos-mosworks, a finite element assessment package. Calculations were made and then forces were extracted in newtons and then converted into pounds. We made the calculations using neck + head, which gave an average weight of 60 newtons (6kg or 13.2 pounds). The center of mass was located 16cm above C7 or 15cm from the top of the skull.

RESULTS

The weight seen by the spine dramatically increases when flexing the head forward at varying degrees. An adult head weighs 10 to 12 pounds in the neutral position. As the head tilts forward the forces seen by the neck surges to 27 pounds at 15 degrees, 40 pounds at 30 degrees, 49 pounds at 45 degrees and 60 pounds at 60 degrees. At 90 degrees the model prediction was not reliable.

DISCUSSION

As far as we are aware, and after a review of the *National Library of Medicine* publications, there is no other study available to assess the stresses about the neck when incrementally moving the head forward.

We are aware that the muscles, tendons, and ligaments dampen the stresses seen by the cervical spine. For our assessments, the calculations of the stresses seen by the neck are for the neck and muscles, including ligaments and tendons. In time, different biomechanical and orthopedic groups will study this same factor.

Good posture is defined as ears aligned with the shoulders and the “angel wings,” or the shoulder blades, retracted. In proper alignment, spinal stress is diminished. It is the most efficient position for the spine. Amy Cuddy and associates¹⁻³ showed that high-power posture posers experienced elevations in testosterone, increases in serotonin, decreases in cortisol, and increased feelings of power and tolerance for risk taking. Low-power pos-

ture posers exhibited the opposite pattern. Poor posture invariably occurs with the head in a tilted forward position and the shoulders drooping forward in a rounded position.^{4,5}

Loss of the natural curve of the cervical spine leads to incrementally increased stresses about the cervical spine. These stresses may lead to early wear, tear, degeneration, and possibly surgeries.

People⁶ spend an average of two to four hours a day with their heads tilted over reading and texting on their smart phones and devices. Cumulatively this is 700 to 1400 hours a year of excess stresses seen about the cervical spine. It is possible that a high school student may spend an extra 5,000 hours in poor posture.

While it is nearly impossible to avoid the technologies that cause these issues, individuals should make an effort to look at their phones with a neutral spine and to avoid spending hours each day hunched over.

Cervical spine surgeons need to pay attention to the alignment and therefore to the stresses about the spine when performing anterior discectomies

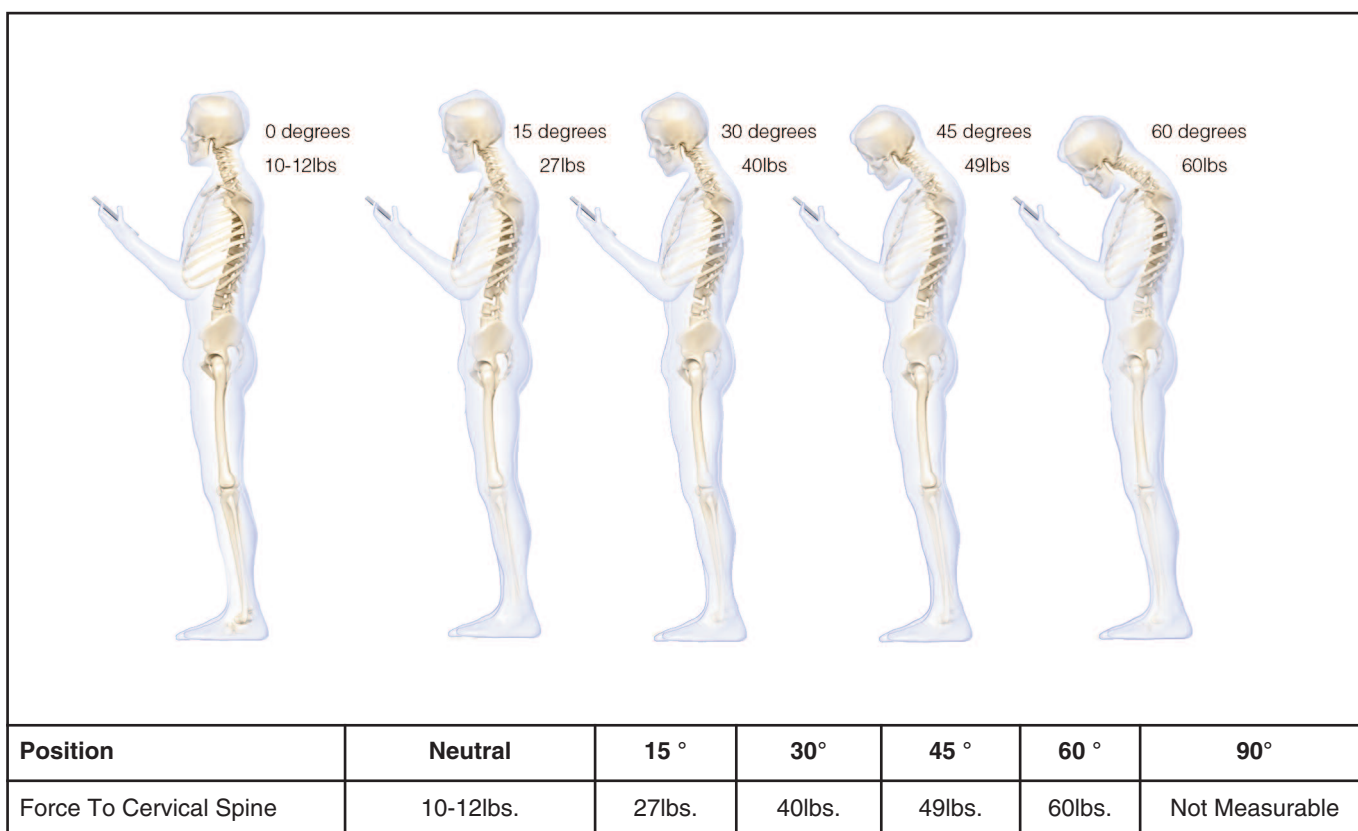


Figure 1. The weight seen by the spine increases when flexing the neck at varying degrees. An adult head weighs 10-12 pounds in the neutral position. As the head tilts forward the forces seen by the neck surges to 27 pounds at 15 degrees, 40 pounds at 30 degrees, 49 pounds at 45 degrees and 60 pounds at 60 degrees.

and fusion along with arthroplasties. With advancing spinal surgical techniques, such as the motion sparing total disc arthroplasty, attention to the final position of the neck becomes critical. Misalignment of a reconstructed segment into kyphosis will lead to a biomechanical disadvantage and more than likely will affect breakdown of the adjacent segment. This paper does not specifically study post-surgical reconstructions per se. However, our findings appear to have a direct implication on cervical reconstructions.

CONCLUSION

The weight seen by the spine dramatically increases when flexing the head forward at varying degrees. Loss

of the natural curve of the cervical spine leads to incrementally increased stresses about the cervical spine. These stresses may lead to early wear, tear, degeneration, and possibly surgeries. While it is nearly impossible to avoid the technologies that cause these issues, individuals should make an effort to look at their phones with a neutral spine and to avoid spending hours each day hunched over. Cervical spine surgeons need to pay attention to the alignment and therefore to the stresses about the spine when performing anterior discectomies and fusion along with arthroplasties. **STI**

AUTHOR'S DISCLOSURES

The author has no conflicts of interest.

REFERENCES

1. Cuddy A. Power Poser - Game Changers TIME content.time.com/.../ 0,28804,2091589_2092033_2109441,00 .html.
2. Huang L1, Galinsky AD, Gruenfeld DH, et al. Powerful postures versus powerful roles: which is the proximate correlate of thought and behavior? Psychol Sci 2011;22(1):95-102.
3. Carney DR1, Cuddy AJ, Yap AJ. Power posing: brief nonverbal displays affect neuroendocrine levels and risk tolerance. Psychol Sci. 2010 Oct;21(10):1363-8.
4. Walsh J1, Eccleston C2, Keogh E2. Pain communication through body posture: The development and validation of a stimulus set. Pain. 2014 Aug 26. pii: S0304-3959(14)00378-9. doi: 10.1016/j.pain.2014.08.019.
5. Data Pew Research Center <http://www.pewinternet.org/> 2013/09/19/ cell-phone-activities-2013/.
6. Harvard Editorial Board: How to soothe a sore neck. The essentials are icing and heat, gentle therapeutic exercise, and good posture. Harv Mens Health Watch 2014;18(11):5.