Spinal manipulative therapy (SMT) has been recognized as an effective treatment modality for many back, neck and musculoskeletal problems.

One of the major issues of the use of SMT is its safety, especially with regards to neck manipulation and the risk of stroke. The vast majority of these accidents involve the vertebro-basilar system, specifically the vertebral artery (VA) between C2/C1.

Here, we present first ever data on the mechanics between C2/C1 during cervical SMT performed by clinicians.

VA strains obtained during SMT are significantly smaller than those obtained during diagnostic and range of motion testing, and are much smaller than failure strains.

[Key Point]

We conclude from this work that cervical SMT performed by trained clinicians does not appear to place undue strain on VA, and thus does not seem to be a factor in vertebro-basilar injuries.

KEY POINTS FROM THIS STUDY:

1) Spinal manipulative therapy (SMT) is an effective treatment modality for many back, neck and musculoskeletal problems. “It has received wide-spread acceptance in a variety of disciplines including chiropractic, physiotherapy, nursing, and mainstream health care.”

2) “One of the major issues of the use of SMT is its safety, especially with regards to neck manipulation and the risk of stroke.”

3) “The estimate of stroke associated (but not necessarily caused) by SMT is small – about one in a million.”

4) It has been assumed [wrongly as per this study] that the VA experiences considerable stretch during extension and rotation of the neck, which may lead to occlusions and damage to the VA, predisposing the patient to stroke.
5) Recent evidence indicates that vertebral artery damage is unlikely to occur between C1 to the foramen magnum, and between VA’s origin from the subclavian artery to C6.

6) “Here, we review the results of existing studies on human VA strains during high-speed, low-amplitude SMTs administered by qualified clinicians and compare them to the strains encountered during full range of motion (ROM) tests, and furthermore, add the summarized results of unpublished works from strains measured from all sections of 8 VAs using data from 3 clinicians, resulting in a total of 3,034 segment strains obtained during SMTs and 2,380 segment strains obtained during full ROM testing.” [This is an extensive study]

7) Tests were performed on 12 human cadavers, 2 embalmed and 10 fresh. All ROM and SMT testing was performed by three licensed chiropractors. The SMT was a diversified lateral/rotational maneuver applied to the recorded spinal regions.

8) The force measurements were performed and measured in such a manner that “if anything at all, the strains during SMTs measured here are likely greater than those one would obtain in a patient.”

9) The mean [not maximum] failure strains of VAs are reported previously to be 58%. All maximum values documented here “are clearly below the mechanical failure strains of VAs with the largest measured value of 22.9% for ROM testing in the V3 region representing about 39% of the failure strain.” [Important]

10) These authors found that “the length change of the VA during SMT is much smaller than that observed during the range of motion testing.”

11) These authors did additional experiments to conclude that repeated treatments, as may occur in clinical practice, could not cause micro-structural damage and failure strain to the vertebral artery.

12) “In summary, the maximal strain values for the ROM testing at each segmental level were always greater than the corresponding strain values for the SMTs, suggesting that neck SMTs impose less stretch than turning your head, or extending your neck while looking up at the sky.”

13) “The results of this study suggest that neck SMTs impose stretches on the VA that are maximally 55% of the passive range of motion achieved with normal movements of the head and neck and are maximally 22% of the observed mean mechanical failure strain of human VAs. Therefore, based on the mechanical tests performed here, one should be able to conclude that stretching of VA during neck SMTs does not cause any damage of the VAs.” [Key Point]

14) “The VA is never really strained during spinal manipulative treatments but that the VA is merely taking up slack as the neck and head are moved during SMT, but that there is no stress and thus no possibility for microstructural damage.”
15) These authors also argue and state that the increased rate of stretch of the VA during SMT was not able to injury the VA.

16) “The results from this study demonstrate that average and maximal VA strains during high-speed low-amplitude cervical spinal manipulation are substantially less than the strains that can be achieved during ROM testing for all vertebral artery segments.”

17) “We conclude that cervical spinal manipulations, as tested here, are safe from a mechanical point of view for normal, healthy VA.”

| Maximum Vertebral Artery Strains as a Percent (%) |
| V1 Below C6 | V2 C6-C2 | V3 C2-Foramen Magnum Dura | V4 Foramen Magnum Dura-Basilar Artery |
| ROM study #1 | 4.9% | NA | NA | 12.5% |
| ROM study #2 | 14.5% | 12.7% | 22.9% | NA |
| SMT study #1 | 8.0% | NA | NA | 2.7% |
| SMT study #2 | 4.3% | 4.6% | 12.6% | NA |