

Where Is the Inferior Angle of the Scapula?

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Some time ago, we initiated a project at Palmer West to test a simple rule of thumb commonly used in our technique department having to do with relating motion-palpation findings to spinal misalignment. I won't go through the details, but suffice it to say that for a variety of technical reasons, although we did in fact gather data, we were not able to address the original research question regarding the accuracy of the technique rule of thumb.

On the other hand, in staring down the data that did emerge, we made a purely serendipitous discovery: The inferior angle of the scapula (IAS), commonly thought to line up in the standing position with the spinous process (SP) of T7, tends to be closer to the SP of T8. In our study, a palpator placed lead markers (BBs) on what was thought to be the SPs of T4, T7 and T10, using the IAS as a landmark to locate these levels. An upright full-spine X-ray was then taken. (The X-ray was taken for clinical reasons unrelated to our study. We were simply "harvesting" information from X-rays that would have been taken anyway.) When we looked at the films later on, we noted that the IAS, rather than lining up with the SP of T7, lined up close to the SP of T8. In other words, using the IAS to find what we thought would be the SP of T7, we actually found the SP of T8 on average.

Please note the terminology: We found the IAS *on average* to be near the SP of T8. The mean location was in fact at T8.03 (SD=.9) with a range from T6 to T10. The strongest statement we could make about the IAS was that it is found on average slightly below the SP of T8 and that there is a one-third chance of it being located between T7 and T9, a three-segment range.

It was something of an epiphany to be confronted with these results - a real "duh" moment. This was true not so much because the conventional wisdom was off by one level, but because we had uncritically imbibed the concept that the IAS would always be at a *particular* spinal level, no matter what particular level that may be. In general, the location of an anatomical structure always conforms to a range, either small or large. It should have occurred to us several decades ago that the location of the IAS might vary from person to person, and even from the left to the right side of the body.

With all this in mind, we decided to do an even more straightforward, standard radiometric analysis study on the location of the IAS. We were fortunate enough to have access to a large stack of upright full-spine X-rays taken by a doctor many years ago who did not use collimation. Thus, the scapulae were visible on the films, even though they are not visualized on films taken by chiropractors who have been more recently trained. We simply inspected these archived films to determine the location of the IAS in relation to the spine.

In analyzing 50 radiographs, we found that the mean spinal level corresponding to the left IAS was very close to the T8 SP and within a three- to four-segment range (the range differed somewhat between the sexes, and for the right and left sides), very similar to the results of our other study. The scapula tended to be slightly lower on the right, presumably related to handedness; and tended to be bilaterally lower by about one-fourth of a vertebral level in males as compared with females. In this study, we also considered the impact of radiological distortion. Since the radiographic beam in a full-spine radiograph penetrates the IAS in an inferior to superior direction,

we calculated that the IAS lays approximately 0.5 cm lower than reported herein, just below the T8 SP on average.

Having performed two studies that used different methodologies but achieved about the same results, we are now reasonably certain that the IAS lies, on average, one level lower than what is commonly believed. This means that the common practice of locating spinal levels using the IAS as a landmark is "frameshifted" one vertebral level. (In genetics, the insertion or deletion of a nucleotide pair is called a *frameshift mutation* because it causes a shifting of the reading frame of the genetic code.) In other words, the rule of thumb leads to a systematic reading error equaling one vertebral level. Moreover, the fact that the IAS lays within a fairly wide range means that patient variation will lead to randomly distributed additional errors of one or two levels. Finally, it is likely that examiner error in locating levels at any intended distance from the IAS leads to further errors. Our first study (the one using BBs) found such errors to be about 1/4 of a vertebral level on average, with a SD of about 0.5. Thus, a palpator using the IAS as a landmark to find another level has, at best, a 67 percent probability of not missing by more than one level above or below the targeted level.

To tell the truth, none of this is very reassuring for our ability to find intended spinal levels using the IAS as a landmark. The combined effects of an incorrect rule of thumb, patient variation, gender and arm-dominance effects, and examiner-measurement error likely lead to a lot of mistakes in locating desired anatomical locations. To make matters worse, it remains to be seen what spinal level on average corresponds to the IAS in the *prone* position. Although this is commonly presumed to be the SP of T6 (one level above the standing level), this may or may not be true. It remains to be seen whether prone palpation is more or less confounded than upright palpation.

In writing our two articles^{1,2} and reviewing the literature, we did find a number of references stating the standing IAS lies at T8, consistent with our findings, or lies at either T8 or T9. However, the preponderance of sources, including all the chiropractic sources we consulted, had it at the SP of T7.

Who should care where the inferior tip of the scapula lies, in relation to the spine? Our findings should be of interest to clinicians in any profession who use the scapula as a landmark for locating other anatomical structures, such as vertebral levels. Such clinicians would include chiropractors, osteopaths, physical therapists, orthopedists, neurologists, anesthesiologists, surgeons, nurses, discographers and possibly others. In other words, the need to correct the conventional wisdom is not merely a chiropractic problem.

For example, let us consider how this might affect the practice of chiropractic. We think it would mostly impact those chiropractors who take X-rays for biomechanical analysis, then attempt to apply forces in either the upright or prone positions to subluxations identified on the upright X-ray. Although it is hard to say for certain how many, this might represent a very sizable proportion of chiropractors - perhaps half of them. Having visualized an X-ray subluxation (however defined), these chiropractors presumably use some anatomical landmark to identify the corresponding spinal location on the patient, from which they palpate up or down to the vertebral level indicated by the X-ray. Depending on location, they may use the vertebra prominens, the IAS or the iliac crest as their landmark. We would expect them to use the IAS, whether the patient is upright or prone, to help localize spinal levels for most of the thoracic spine. Given all the vagaries listed above that complicate this task, beginning with the frame-shift consequences of using an incorrect rule of thumb for the upright position, and ending with the fact that the rule of thumb for the prone position is not yet known, we think they are off their mark more often than not, perhaps by several levels.

Let us work through an example. A subluxation is identified at T9 on the film. The doctor attempts to locate and palpate this level on a sitting patient using the T7 SP = rule of thumb and thus winds up on average one level lower than intended, at T10. However, it also turns out that this particular patient's IAS happens to lie at T9, so the chiropractor actually winds up at T11. Finally, the non-negligible possibility of examiner error in counting down two spinal levels from the IAS could result in the chiropractor winding up at T12, three levels away from the intended T9! Until such time as we know the IAS location in the prone position, spinal targeting in the prone position could be either more accurate or less accurate than upright palpation. It just may be that the prone IAS is not, on average, one level higher than the upright level, as is commonly supposed. (We have some preliminary information on this matter, but are not prepared to publish it just yet.)

Although we are not presently offering up any opinions as to how this conundrum affects the safety and effectiveness of chiropractic adjustive procedures, it is probably not a good idea to be unaware of what level is being adjusted or how it relates to a radiographic finding. If segmental specificity has an important impact on the outcome of chiropractic care, our findings suggest the quality of chiropractic care could be enhanced by recognition and reduction to practice of our findings. We will be writing a paper developing these points in more detail. In the meantime, an interested reader might read our two publications.^{1,2} We don't know what it is going to take to widely publicize our findings, but we fear simply publishing them may not be good enough. People don't like parting ways with conventional wisdom, especially when it is very, very entrenched - such as a spinal landmark taught everywhere since time immemorial. We may start out by trying to convince the faculty member who occupies the office right next to Dr. Cooperstein, since the former individual teaches spinal anatomy at our college. If you, the reader, find merit in our work, please drop us a line.

References

1. Haneline M, Cooperstein R, Young M, Ross J. Determining spinal level using the inferior angle of the scapula as a reference landmark: a retrospective analysis of 50 radiographs. *J Can Chiropr Assoc*, 2008;52(1):24-9.
2. Cooperstein R, Haneline M. Identification of thoracic spinal levels by palpation versus an X-ray gold standard. *J Chiropr Med*, 2007;6(3):87-93.

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