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STARTLING IGNORANCE

Arguing about technique variations is pointless without clear definitions and data.

BY LON KILGORE



A look at what we actually know about technique and injury



- Don't look here, look up, that's where you want to go.
- 90-degree knee and no deeper.
- EMG says upper arm only goes to parallel.
- Breathe in going up.
- Any way you can.
- Safety first!
- Now make sure your knees don't go over your toes.



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Good exercise technique versus bad exercise technique: Everyone seems to have an opinion about what makes a movement acceptable and what makes it unacceptable.

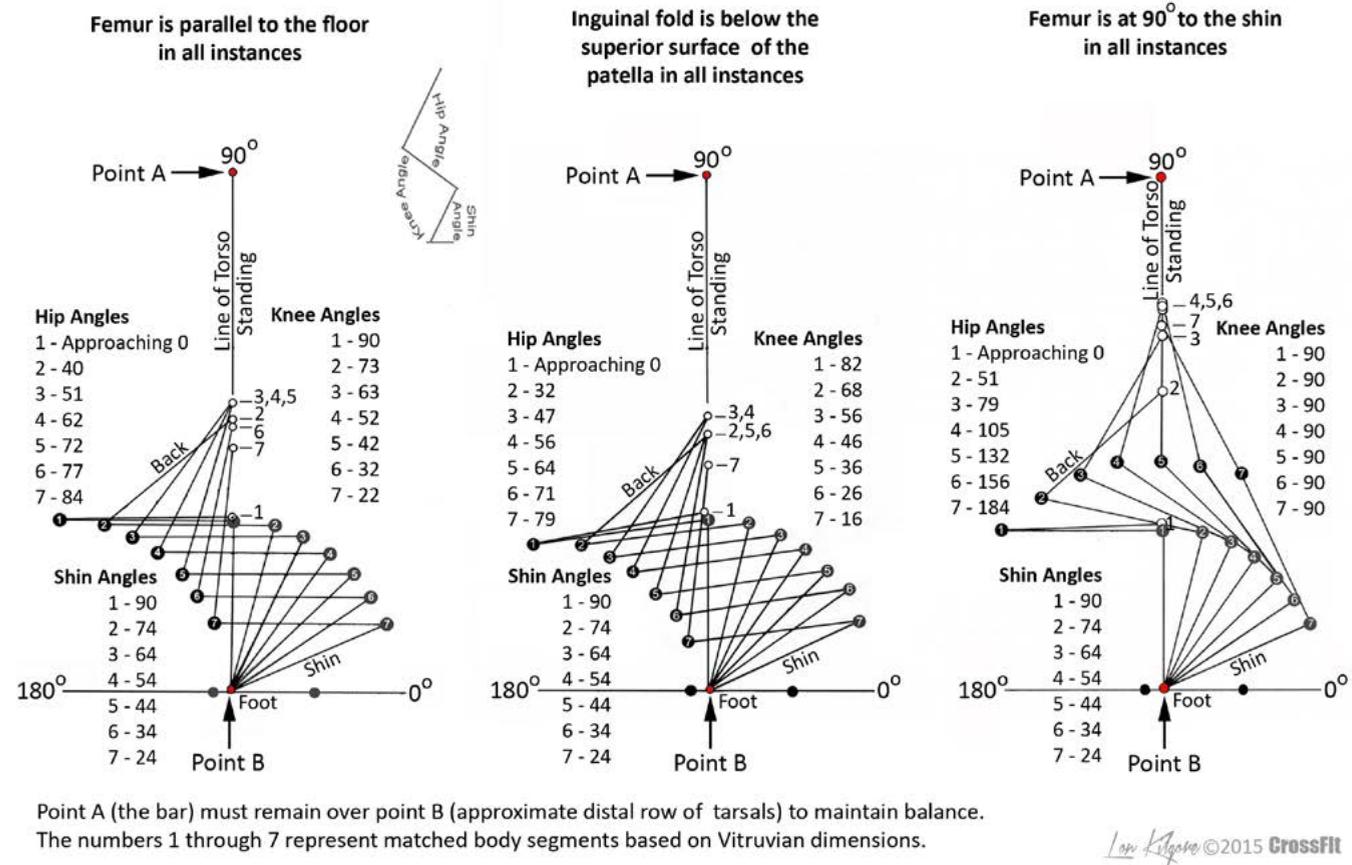
The mantra of every book, article and blog post on exercise injury or gym safety is “bad technique causes injury.” But in the fitness industry, no one agrees on the exact elements of good technique, and despite a lack of agreement, certain groups within the industry will heap criticism upon anyone who does not adhere to their version of good technique. This occurs even if these groups themselves cannot reliably define and describe good technique for any given exercise.

This is not to say technique is not important. It is. When we teach any exercise techniques, we need to ensure:

- The execution of the exercise matches the intent of training: What is to be accomplished and/or developed?
- The movement conforms to basic physics and anatomy: Does the movement conform to laws of motion, and is it within an anatomically achievable range of motion?
- An appropriate training progression has prepared the trainee to successfully perform the exercise in the prescribed volume and intensity.

Among others, organizations such as the American College of Sports Medicine (ACSM), the National Strength and Conditioning Association (NSCA), and the American Council on Exercise (ACE) have been publishing and selling their versions of good exercise technique for many decades. As such, these organizations appear to be established authorities that provide easily accessible information upon which a new trainer can base practice.

But can we actually base the concept of safe technique upon the opinions of such organizations—organizations that present themselves as world leaders?



Possible squat-position variations derived from descriptions and images in the “Journal of Strength & Conditioning Research” (27[1]: 147, 27[1]: 149, 27[3]: 751, 28[4]: 1130) and NSCA publications “Essentials of Strength and Conditioning” (third edition) and “Basics of Strength and Conditioning Manual.”

A Lack of Precision and Agreement

If we review publications from fitness groups, most technique descriptions are generally no more than a paragraph or two placed alongside a photo or two. It wasn't until 2005 that people began looking deeper into the issues of technique, after Mark Rippetoe and this author wrote and illustrated a 60-page treatise on squat technique and teaching the squat (7). Unfortunately this deeper consideration did not extend to the academic exercise organizations.

The current version of the NSCA's “Essentials of Strength Training and Conditioning” has but 22 bullet points and a four-image sequence on how an athlete should perform a squat (6). We also know that the NSCA does not have consistent descriptions of exercise technique for the same movement across its instructional publications (see this author's “You Be the Judge” series on The Russells blog).

The ACSM does not include descriptions of weighted exercise technique in its authoritative “ACSM's Guidelines for Exercise Testing and Prescription”: The book contains about four pages on the physiology of resistance training and a half page with relevant-to-irrelevant programming and general-methods information (1). The most cogent statement made is that good technique is marked by “complete range of motion.”

IT JUST MIGHT BE THAT THE FITNESS INDUSTRY HAS BASED ITS ENTIRE APPROACH TO TECHNIQUE ON THE HISTORICAL EXPERIENCES OF TRAINERS AND COACHES OR POSSIBLY ON UNSUPPORTED CONCEPTS. THE FORMER IS MODERATELY ACCEPTABLE, AND THE LATTER IS COMPLETELY UNACCEPTABLE.



Note the knee position in each squat. Elite athletes employ various techniques with great success and therefore offer no definitive information as to what constitutes “good technique.”

In the traditional fitness industry, we really don't have a reliable reference publication that defines and demonstrates good and bad technique, though CrossFit Training is working very hard to change that. It just might be that the fitness industry has based its entire approach to technique on the historical experiences of trainers and coaches or possibly on unsupported concepts. The former is moderately acceptable, and the latter is completely unacceptable.

So how is good technique currently identified?

In general, exercise technique is described as good if it is somewhat similar to that of elite-level performers (weightlifters, powerlifters, bodybuilders, runners and so on). But review the techniques of elite athletes at any competition and you will note large variations in movement patterns. Which elite athlete is the true model? This is obviously a flawed approach to defining exercise technique. Similarly, injuries occur in competition more frequently than in training, so the safety aspect of the technique used by elites could be contested.

While the absence of consistent descriptions of good technique is a problem in itself, a much more insidious issue is the use of the ad hominem argument that states bad technique causes injury. Without a foundation based on data and a viable definition of good technique, this argument is nothing more than a weapon to promote one system of exercise over another. If an organization cannot define good technique with experiential, theoretical or experimental data, how can it define bad technique? How can it state that one approach is better than others and that other systems are injurious because of technique variations?

Technique and Injury

So does any evidence show that different versions of the same exercise are injurious due to technique variations? With so many different exercises and names for exercises, it's impossible to answer the question with certainty. But let's take a snapshot



Note that the lifter's right thumb is not wrapped around the bar. What, if anything, does that tell us about appropriate lifting technique?

look at the current state of affairs by considering a stalwart of exercise training that also serves as a classic example of how fear mongering changes exercise technique: the sit-up.

The sit-up has received “authoritative” attention from a variety of academic and professional exercise organizations that say they teach or present safe and effective instruction in exercise technique. But does a convincing body of evidence tell us how to perform and teach this exercise? And does a body of evidence prove injuries will occur if trainees do not use a certain technique?

(Author's note: the article from here forward will undoubtedly ruffle some feathers as it only includes a few citations. The intent of this paper is to demonstrate current conditions to open

discussion, not to provide a comprehensive and exhaustive review of all literature.)

In the 1960s, we performed straight-legged sit-ups in school fitness tests, but then an opinion arose that straight-legged sit-ups would cause injury to the lumbar vertebrae, and we started doing bent-knee sit-ups. Then a newer opinion evolved and suggested sitting all the way up with the hands behind the head would cause injury to the cervical vertebrae, so we crossed our hands in front of our chests and started doing sit-ups with incomplete range of motion, also known as crunches.

Interestingly, no reports of injuries caused by sit-ups can be found at any stage of technique evolution. The four individual reports of injury from sit-ups listed on PubMed, the search

tool for the National Library of Medicine, were published in 2006 and 2009 and involved modern techniques. It's tempting to clap the hands and say the new sit-up techniques cause injury, but we can't: In these cases, sit-ups were a secondary condition to injury (2,3,8). This means a pre-existing condition was present, and sit-ups cannot be considered the sole cause.

In one case study, any abdominal contraction could have aggravated the teratoma present, and if the cyst was not present, then there would have been no injury from sit-ups (2). In the second case study, at the conclusion of wrestling practice a teen did 2 sets of 50 sit-ups and then reported the injury. The injurious agent cannot be determined: some part of the wrestling practice, the practice and sit-ups combined or the sit-ups alone (3). The authors of this latter 2006 paper stated in their introduction, “There are no reports of cervical spine ligamentous or spinal cord injuries (SCI) occurring during ‘sit-ups.’” The final two cases indicated the Valsalva maneuver as a cause of neurologic symptoms after doing sit-ups. In one of these cases, magnetic-resonance-imaging (MRI) evaluation demonstrated a cerebral-artery blockage as another injury agent (8).

Without a large collection of documented injuries, why did we change sit-up technique?

The only reason any form of sit-up is considered injurious is because biomechanical forces on the vertebral column increase when you do sit-ups, not because of a known and demonstrated mechanism of injury in living humans. Remember that previous authors have stated ligamentous and spinal-cord injuries from sit-ups have not been documented in the literature (3).

THE ONLY REASON ANY FORM OF SIT-UP IS CONSIDERED INJURIOUS IS BECAUSE BIOMECHANICAL FORCES ON THE VERTEBRAL COLUMN INCREASE WHEN YOU DO SIT-UPS, NOT BECAUSE OF A KNOWN AND DEMONSTRATED MECHANISM OF INJURY IN LIVING HUMANS.

Often with variability that depends on personal, institutional or organizational bias, researchers liberally interpret biomechanical data as indicative of injury risk: increased electromyograph activity, compression, shearing force and torsion at single or multiple vertebral joints or at the hip in cadaver specimens or computer, animal, or human models.

Such papers are very common, and their conclusions on technique generalize data to exercising humans and predict injury in conditions where none have been reported. These empty conclusions affect us in the gym because academic and professional organizations, manufacturers, and even bloggers seize upon the data to promote their methods, their products or themselves. If an opinion is stated often enough and loudly enough, it is often considered fact.

For example, we are often told with an air of certainty that sit-ups or repeated sit-ups will cause degeneration due to compression of the anterior discs. (This argument also pops up in discussions about the squat). However, in an MRI study of middle-aged workers “disc degeneration was not related to body height, overweight, smoking, or the frequency of physical exercise” (4).

If exercise is not related to disc degeneration, and without a wealth of injury data, can we really point an accusatory finger at the sit-up? Some will say we can, but the merit of the current arguments against sit-ups does not outweigh the fitness and functional benefits of the movement.

“No biologically significant differences were found between bent knee and straight leg sit-up techniques,” Stuart McGill wrote in a study published in *Clinical Biomechanics*. Yet McGill questioned whether using either movement in an exercise program was appropriate due to possible injury risk.

Function or Fear?

Without a documented history of injuries to guide us, should we avoid programming exercises while acting for the benefit of our trainees and their readiness to resist similar stresses in daily life?

Any time we exercise or move in general, basic physics dictate that biomechanical forces within and applied to the body increase. The body is built to adapt and improve resistance to disease and injurious forces. Should we seek to eliminate these forces from our training and lives or progressively train to enable easy tolerance of those forces?

No one has established causality between exercise technique and injury. While relying on data, we cannot say one exercise technique is better than another. But this is not an open invitation to a Wild West application of wantonly irresponsible exercises and techniques. To the contrary, it

is a call to action to systematically and objectively create definitions and descriptions of techniques. CrossFit has openly published its definitions of technique—both written and visual—for all to review and discuss. The evolution of these descriptions continues as trainers and trainees provide feedback and performances are evaluated.

Letting someone else—in this case CrossFit—do the heavy lifting of improving practice is not the final solution; it is a step.

We—you and I—need to ask appropriate questions that will help us in practice, we need to design relevant studies that answer the appropriate questions, and we need to disseminate the resulting information to everyone involved in fitness.

These inquiries do not have to be elaborate, as simplicity makes for good science. They can take place in your gym. You know your business, and you know your trainees. You can ask questions relevant to your practice better than anyone. Keep records, objectively analyze them, share your findings with others, collaborate with local universities and above all do not be afraid to question anything that is taken for granted as fact in the fitness industry. ■

References

1. American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription (7th Edition)*. Pescatello LS, ed. Lippincott, Williams & Wilkins, Philadelphia, Penn.: 2006.
2. Chang YT and Lin JY. Intraperitoneal rupture of mature cystic ovarian teratoma secondary to sit-ups. *Journal of the Formosan Medical Association* 108(2): 173-5, 2009.
3. Dickerman RD, Mittler MA, Warshaw C, and Epstein JA. Spinal cord injury in a 14-year-old male secondary to cervical hyperflexion with exercise. *Spinal Cord* 44(3): 192-5, 2006.
4. Luoma K, Riihimäki H, Raininko R, Luukkonen R, Lamminen A, and Viikari-Juntura E. Lumbar disc degeneration in relation to occupation. *Scandinavian Journal of Work, Environment & Health* 24(5): 358-66, 1998.
5. McGill SM. The mechanics of torso flexion: situps and standing dynamic flexion manoeuvres. *Clinical Biomechanics* 10(4): 184-192, 1995

6. National Strength & Conditioning Association. *Essentials of Strength Training and Conditioning (3rd Edition)*. Baechle TR and Earle RW, eds. Human Kinetics, Champaign, Ill.: 2008.

7. Rippetoe CM and Kilgore JL. *Starting Strength: A Simple and Practical Guide for Coaching Beginners*. Wichita Falls, Texas: Aasgaard Co., 2005.

8. Uber-Zak LD and Venkatesh YS. Neurologic complications of sit-ups associated with the Valsalva maneuver: 2 case reports. *Archives of Physical Medicine and Rehabilitation* 83: 278-82, 2002.

AUTHOR BIO

Lon Kilgore earned a Ph.D. from the Department of Anatomy and Physiology at Kansas State University's College of Veterinary Medicine. He has competed in weightlifting to the national level since 1972 and coached his first athletes from a garage gym to national-championship event medals in 1974. He has also competed in powerlifting, the first CrossFit Total event, wrestling, and rowing. He has worked in the trenches, as a coach or scientific consultant, with athletes from rank novices to professionals and the Olympic elite, as a collegiate strength coach, and as a consultant to fitness businesses. He was co-developer of the Basic Barbell Training and Exercise Science specialty seminars for CrossFit (mid-2000s). He is a qualified National Coach and was a certifying instructor for USA Weightlifting for more than a decade and a frequent lecturer at events at the U.S. Olympic Training Center. He is a decorated military veteran (sergeant, U.S. Army). His illustration, authorship and co-authorship efforts include the best-selling books "Starting Strength" (first and second editions) and "Practical Programming for Strength Training" (first and second editions), "Anatomy Without a Scalpel," "FIT," "Deconstructing Yoga," magazine columns, textbook chapters, and numerous research-journal publications. His professional goal is to provide the best quality, most practical, most accessible and highly affordable educational experiences to fitness professionals through his university work and through his curriculum-development work for universities and for continuing education for the fitness industry. His students have gone on to become highly notable figures in weightlifting, powerlifting, cycling, sport coaching, fitness, and academia.



By directing uninformed arguments and accusations against CrossFit coaches without providing any objective and measurable evidence, detractors demonstrate their willingness to throw rocks inside their own glass houses.