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The Measure of a Man
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Simple questions are sometimes the most profound. And answers to simple questions about exercise sometimes do not exist in print; rather, they are often intuitive to skilled coaches or contained in knowledge that is that is passed on in the lore of the gym rather than recorded in books or formal training programs. Expert coaches, teachers, clinicians, and professors sometimes take it for granted that what we think is basic, simple common knowledge is apparent to all.

Recently, during the course of shooting video footage for a DVD project spearheaded by Mark Rippetoe, Rip made a number of comments about arms being short, legs being long, and various and sundry other references to body segments not being of the usual proportions. (Imagine Rip's usual colorful descriptions here.) One particularly humorous comparison of one of our early book models to a Tyrannosaurus Rex made Katie from CrossFit NorCal ask a question: "How do you know someone's arms are longer or shorter than normal?" It was a simple but very good, insightful, and germane question. But it is a question that, as far as I know, is not treated in the exercise literature anywhere.

Movement, specifically technical movement in exercise and sport, is subject to anthropometric and geometric influences. This means that how people's bodies are put together and the relative sizes of the various parts affects how they look and perform when doing certain movements. Just think about obvious cases of this truth—NBA centers and NFL offensive linemen, for example. Their build suits the demands of their sport and position, and so the best players in a given physical sport usually have similar dimensions. Soviet sports scientists even had a set of target anatomical dimensions they used in selecting developmental athletes in various fields to increase the likelihood of individual and team success. Championship teams are frequently built by recruiting players with the right bodies and skills—as much as by elite coaching.

The average trainer, coach, or physical educator must have a functional understanding of how differing anatomical phenotypes (different body dimensions and body-segment lengths) affects the way proper technique looks. To do this, one must first have a reference point and have a means to mentally and visually comprehend typical segmental relationships. Some of this is intuitive in good coaches, but, as Katie's question makes clear, we also need a more concrete way to determine whether an individual's torso is longer or shorter than average for someone of that height, whether the arms are of average length or not, or whether there is a difference in leg length that is significant to the movement in question. If there is a difference it needs to be localized: Is it in the upper arm vs. forearm, or in the shin vs. the thigh? A savvy coach will have a knack for this determination. It is a handy skill. Being able to see, at a glance, how a trainee's body dimensions compare to an average template helps us place the trainee in correct, efficient, and safe exercise positions. Being oblivious to anthropometric considerations means that we cannot teach our trainees how to exercise to their best benefit for the biggest gain in fitness. Being oblivious means that we may, without intending to, place trainees in positions that can decrease their efficiency and even increase their risk of injury.

Fortunately, we do not need to develop a new and elaborate system for doing such an analysis. We can simply take a trip back to the Renaissance to revisit the works of Leonardo da Vinci. Virtually everyone exposed to exercise, anatomy, sport, or da Vinci has seen his drawing of a man in a circle in a square, known as the Vitruvian Man (after Vitruvius, an architect

contemporary to da Vinci who analyzed human dimensions based on four finger widths). Lots of sport and exercise academic programs and even fitness businesses use the Vitruvian Man in their logos. But the Vitruvian Man is not just a cool drawing; it is da Vinci's attempt to map average human dimensions (the average human phenotype or average anthropometry). Da Vinci's notes on human proportions include the following observations:

- The length of a man's outspread arms is equal to his height.
- From the bottom of the chin to the top of the head is one eighth of his height.
- The greatest width of the shoulders contains in itself the fourth part of man.
- From the elbow to the tip of the hand will be the fifth part of a man.
- From the elbow to the angle of the armpit will be the eighth part of man.

This may be more precise than we need for determining proper movement positions, but what is interesting is that for the past half millennium or so, while physical educators, coaches, and other fitness professionals have ignored it, artists and art teachers have derived systems of representing the "average" human form largely based on DaVinci's works. In these systems the human head is used as a reference length in determining the total length of the body, the length of body segments, and their placement on the body. The most common models use either seven and a half or eight head lengths to establish the height of the average body (figure 1).

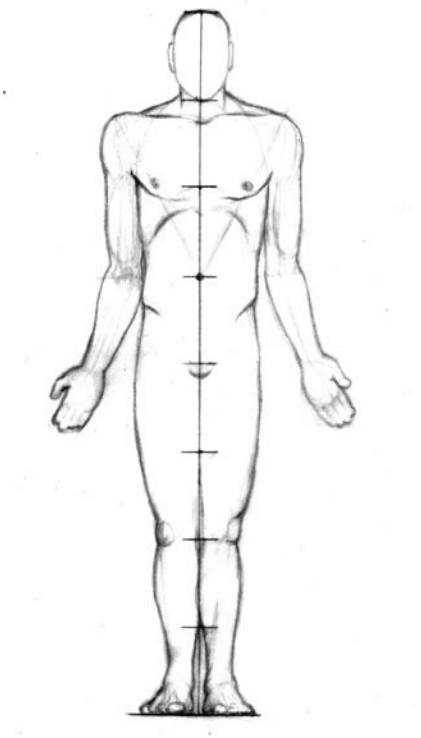

Figure 1. The 8-head model of representing average human dimensions. This is not an absolute model, rather a general guideline for convenient reference for beginning fitness professionals. As the "coaching eye" develops from years of observation and analysis of the human form, less reliance on artificial constructs will be needed.

In these models, various anatomical landmarks are a specific number of head lengths distant from the top of the head or the bottom of the feet (figure 2*).* A perceptive coach can use this generalized system to determine whether a trainee has normal anthropometry or has particular segments that are longer or shorter than predicted by the "average" model. We can

figure out whether a trainee's upper arm is long or short if we know that, on average in the eight-head model, the elbow is at about the same level as the belly button. An elbow observed to be well below the level of the belly button indicates an arm—or at lest an upper arm—longer than average, if the torso length is average. Likewise, an elbow well above that level indicates either a shorter than average segment (arm or upper arm) or a longer than average torso (figure 3). Deviations from average anthropometry will necessarily change the geometry of positions and movement. This means that the same exercise movement will look different, sometimes subtly and sometimes dramatically, in individuals with different segment lengths.

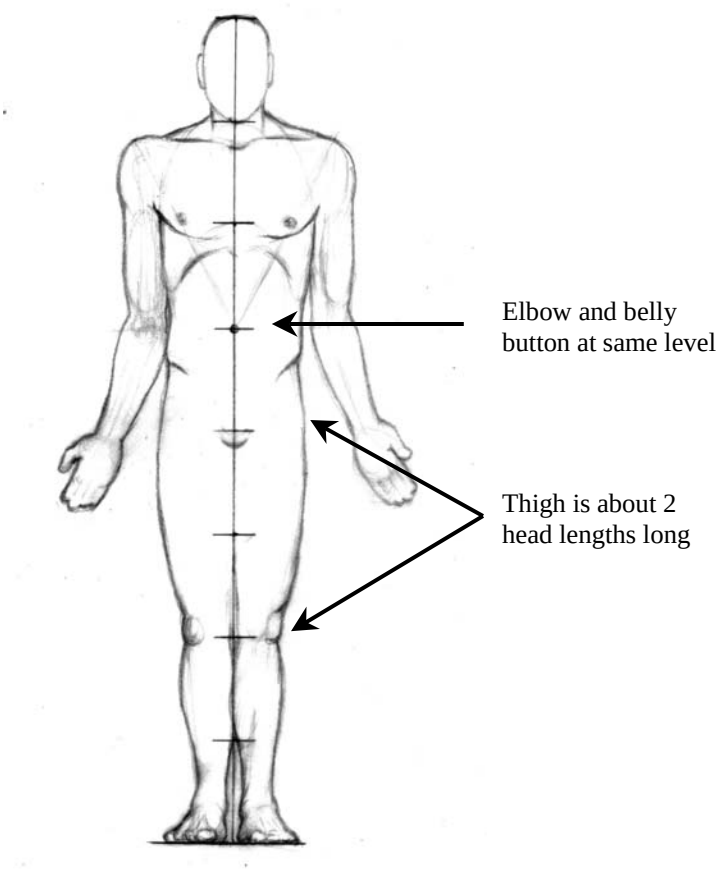

Figure 2. Important landmarks and features of the 8-head model.

Figure 3. Two individuals with anatomical segments that deviate from average. On the left, note that the elbows do not extend to the level of the navel or below and that the fingertips are at the level of the hip joint rather than at the level of the upper thigh. On the right, note the length of the legs relative to the torso. You should be able to see that the lengths are not average. You will see these types of variation in anatomical structure regularly, if you take the time too observe carefully. You should be able to teach individuals just like these how to exercise correctly and safely by accommodating their structural differences. Sometimes it is not until you see someone moving that segment length variations become apparent to the eye, especially when the trainee is exercising in loose clothing.

In barbell exercise, correct and efficient positioning means the difference between a safely executed exercise yielding big gains or potential chronic soreness and small increases in strength. An example of this is in the start position for the deadlift or power clean. Something seemingly innocuous like arm length can make a correct start position look quite different in different individuals (figure 4). In some instances the anatomical variations may be so extreme that an exercise must be modified in order to accomplish the purpose of the exercise with

adequate safety (figure 5). When faced with extreme deviations, thoughtful analysis and experimentation is required in the modification of the exercise. We do not force the individual to attempt to occupy spaces and positions that their bodies cannot geometrically assume (this is not in reference to flexibility issues).

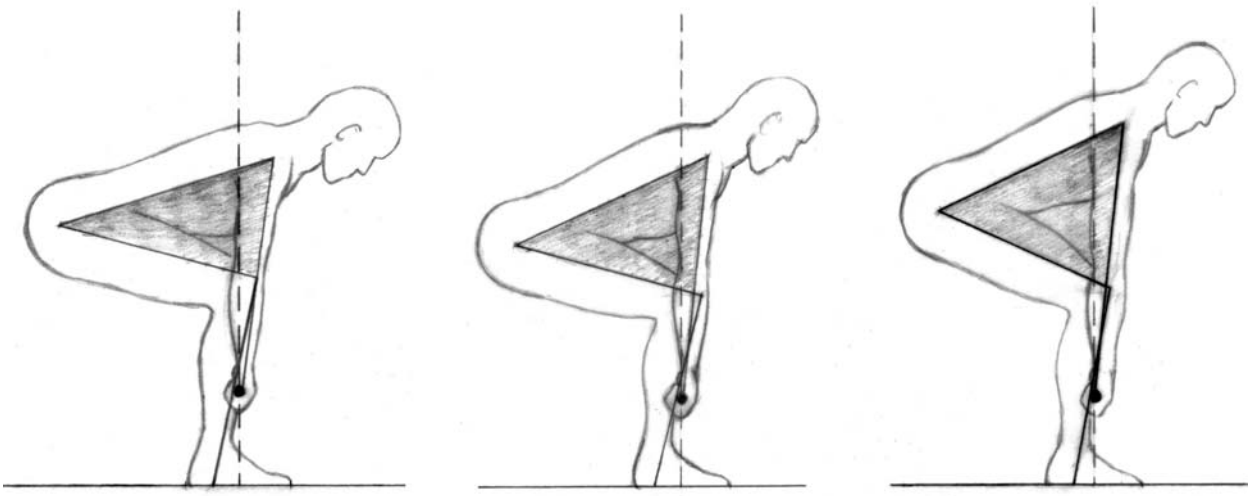

Figure 4. A comparison of the deadlift start position with short vs. average vs. long arms (left to right). Note the change in shape of the central triangle. As the length of one side of the triangle changes length, all of the component angles change. This makes each of the technically correct starting positions depicted above look different. The example presented here only varies in arm length. The situation becomes more complex if multiple segments deviate from average.

Recognizing segmental differences is half the battle; knowing what to do with them is the other half. Segmental differences can affect grip, stance, start position, jump position, and pretty much every aspect of barbell exercises. For example, in the snatch we want a grip as wide as feasible to reduce the distance the bar needs to travel; short arms mean a narrower grip and long arms mean a wider grip on the bar. Similarly, long forearms usually require the trainee to assume a wider grip when racking the weight on the shoulders for pressing or when receiving the bar during a clean. Any time a guy with a big beer gut pulls a bar off the floor, the larger-than-average belly segment must change the geometry of the stance. A little wider stance with the toes pointed out a little more than normal is needed to allow the proper lifting mechanics to happen, and to give the belly a little room to hang out. Long thighs necessitate a higher hip starting position (and therefore a more horizontal back position) off the floor in pulling motions. Shorter thighs mean a lower hip position and a steeper back angle. Longer arms mean that in the power clean, the bar will be lower on the thighs in the jump position than we would like, but things are the way they are. If the trainee is built like Magilla Gorilla and the bar is only two inches above the knee when it's directly under the most forward point of the shoulder blade, you reinforce that to the trainee as the correct position based on his physical construction. Don't tell him to hit the bar higher on his thigh as that will likely cause him to start pulling with bent arms to try to do what you are telling him to do.

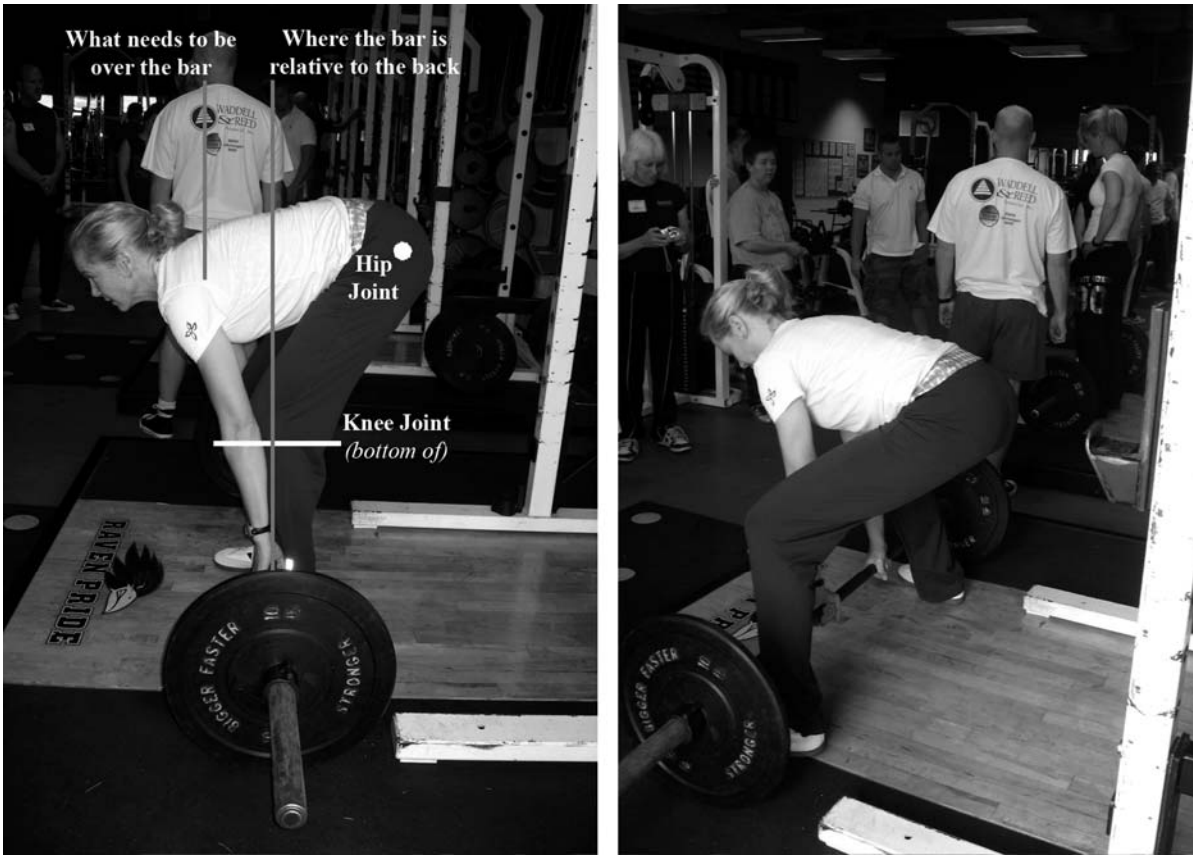

Figure 5. Occasionally a coach is presented with an individual with anatomical structural differences that require wholesale changes in exercise technique. In setting up a correct deadlift, the bar should be placed over the mid-foot and under the middle of the shoulder blade. In this individual, very long thighs make the geometric solution impossible with standard technique (left). In this situation, if her hips were lowered, the shins would move forward, the bar would be pushed well out over the toes, and the shoulders would be behind the bar. The solution was to prescribe the Sumo style of deadlift thus allowing the mid-foot, bar, and shoulder blade to come into proper alignment (right). While not optimal form for comprehensive development, it is a solution that allows the inclusion of the deadlift in this person's training in as safe and as effective manner as possible.

Anyone who lifts or works with lifters, whether as a professional trainer, an amateur coach, or just a lifting buddy needs to recognize that there isn't a one-size-fits-all template for body angles that every body must conform to. If you recognize an anatomical deviation and don't know how to approach it, think about it, draw it out, experiment, and talk to other trainers. Solving this kind of movement problem is simply a complex geometry problem. With a little time and creative mental effort, you can typically arrive at a solution for your trainee.

Anatomical segment differences can also affect a multitude of other exercise or sport skills. Just think of every televised boxing and mixed martial arts contest you have ever seen. Remember the "tale of the tape" comparing the two combatants? Does arm length affect the fighting style used by a combatant? Of course it does. Look at the oarlocks on a rowing shell, why do they have the capacity for adjustment? Although elite rowers are all generally tall, there is enough segmental variation among them that equipment settings need to be adjustable to maximize performance.

At the most basic level, a coach or trainer in any physical discipline must develop a rudimentary level of anatomical understanding just to be able to teach and coach movements correctly (an understanding of very basic geometry helps a bit too). But you will notice that nowhere above did we mention the name of a single muscle or bone. At this, the most simplistic level of movement analysis, a detailed knowledge of anatomy is not required. The important thing is having the ability to identify segments and assess their length relative to average, knowledge of the key points of effective lifting positions, and understanding of how atypical lengths affect these movement patterns. Of course, this doesn't mean that the need to study anatomy ends here, but learning this first and oft neglected coaching skill marks the initial step in the application of physiological principles to movement mastery.

Lon Kilgore, Ph.D., is professor of kinesiology at Midwestern State University, where he teaches exercise physiology and anatomy. He has extensive experience as weightlifter, and he has worked as coach and sports science consultant with athletes from rank novices to collegiate athletes, professionals, and Olympians. He is coauthor, with Mark Rippetoe, of the books *Starting Strength*: *Basic Barbell Training* and *Practical Programming for Strength Training.*
