Compressive strength is the degree of resistance to being compressed. Two external forces acting on opposite sides and in the same line against an object cause compressive stress. When you stand up, your bones resist being compressed. If your bones could not resist compression, your body would spread into a sci-fi-like blob on the floor due to the attraction of gravity. This would happen to you on Jupiter, bones or no bones, because the gravitational force there is so much greater than on Earth. In your body, bones are best at resisting compressing forces. Tendons, ligaments, and muscles are built to resist tensile forces. If this were not so, your arms, which are primarily held in place by ligaments, muscles, and tendons, would drop to the ground as the result of the continuous pull of gravity.

Other forces in the human body include shear, torsion, and bending. Experienced at the fulcrum-lever contact area in imbalanced first-class levers, shear causes a body surface to slide over an adjacent surface. Such bending occurs when a load is placed on a supported beam. The magnitude of bending depends on the load's weight and the distance between the load and the supports. Bending is a combination of shear, tensile, and compression stresses. Torsion develops when forces act on a rod or shaft that tend to twist it; again, tensile, compression, and shearing stresses are at work.

Just as the previously mentioned forces are working in the human body, any structure made by humans exemplifies these forces at work. Bricks in a wall resist compression. Cross beams transfer the weight of a floor to the walls. The beams need to resist bending, so if one starts to bend, a brace must be installed. In much the same way, you reduce your risk of injury by refining your alignment and movement patterns to help keep harmful stresses and strains at bay.

Even your inflating lungs provide a certain amount of support. At the gymnasium I attended in Switzerland, we played soccer in a rounded structure called the *balloon*. Based on the principles discussed previously, this sizable outdoor gymnasium without walls or cross beams was supported by slightly increased atmospheric pressure inside the plastic walls. The plastic cover needed to resist being pulled apart; a hole would make the structure collapse. The hull of the balloon was the structure's tensile element. The weight of the cover was resisted by the air, which, if it is contained, resists being compressed like a wall.

Ability to Resist Force

Take a small rubber band and stretch it until it breaks to discover its maximum tensile strength (but watch your fingers!). It reaches maximum at the moment just before it breaks.

DYNAMIC STABILITY

The concept of stability is commonly used in exercise, dance, and athletic conditioning, but sometimes in confusing and contradictory ways. To better understand these concepts, you will imagine a few books stacked up on the coffee table. They are stable because they will not go anywhere unless someone tilts the table or they are carried off. The books can be defined as statically stable. The tilting of the table reveals their robustness, another important term to understand. The robustness of the books shows how much they can resist sliding off the table when you tilt it. If you tilt the table slightly, the books will probably not move, but at a certain point they will start sliding on top of each other as friction is overcome.

I have just described a statically stable system that was disturbed and became unstable. If you see anything that is at rest, it is stable, but this may not necessarily reveal its robustness. Imagine a nice beach where you can see a big stack of towels and also a palm tree. The stack of towels and the tree both are stable. Suddenly a strong wind comes up. The stack of towels is disrupted and collapses. The palm tree is more robust and simply sways with the wind. Both systems were stable, but only the palm tree can move and come back to its original position once the wind has stopped (unless it's a hurricane), making it also dynamically stable. Dynamic stability is the ability to move and be stable at the same time.

The human body obviously needs to be dynamically stable. Imagine that you are running along the beach. As you do this, you are generating forces from within your body and dealing with forces that are arising from outside your body. The ground is pushing against your feet at changing angles with each step. The sand is not even; it has slants and dips that could throw you off and sudden gusts of wind arise, but through ingenious counterbalancing (much of which you are not even consciously thinking about), you remain on your path. Your stability as a dynamic system can be described as staying on your path (trajectory) while dealing with incoming forces with the help of sensory feedback.

If you pick up the stack of towels and run with them, they will rapidly tumble off of your hands, unless you compress them from below and above. The towels are only statically stable; they lack a system that recognizes a disturbance (your hand, wind, acceleration). The stack of towels does not have feedback from a nervous system telling it what is going on and how to react to remain a stack. Such systems can be stabilized by static means; you can push the towels together from above and below as you run. Now your nervous system is taking over the feedback for the towels, which have none. If you transfer this information to alignment, you conclude that dynamic alignment will work best if your feedback is in place—in other words, if you are good at noticing whether your posture is ideal for any given movement or situation. You must process this information rapidly and accurately to be effective. A static model of alignment will not serve this purpose. A person trying to maintain his alignment by the same unchanging strategies through a movement path will actually be using a static model of alignment. Trying to keep your bones stacked in the same alignment or certain muscles contracted as a postural strategy does not take into account that even the slightest shift of body position requires a different set and subset of muscle contractions. This is what happens to people with back pain, in fact—their ability to shift stabilization strategies is reduced (Brumagne, Cordo, and Verschueren 2004). In a healthy individual, the nervous system is adept at sorting out the different alignment avenues that serve the needs of the variable situation. In dynamic alignment you allow your body to find a new equilibrium as an ongoing process. This is where good proprioception (feedback) and effective imagery (feedforward) come into play.

According to Vleeming and colleagues (2004), "Optimal stability is achieved when the balance between performance (the level of optimal stability) and effort is optimized to economize the use of energy" (p. 11). The amount a joint should be compressed should be the minimal amount necessary and tailored to the situation. Any type of cueing, both cognitively and with imagery, should enhance the economy of movement and keep joint pressures at the minimal necessary state for optimal functioning.

If you want to change the shape of a certain structure, it requires force; the amount of force required is the stiffness of the structure. The key when it comes to dynamic alignment is performance, which Reeves defines as "how closely and rapidly the disturbed position of the system tends to the undisturbed position" (Reeves, Narendra, and Cholewicki 2007, p. 270). In other words, what counts is your ability to deal with a disturbance and return to your original posture rapidly. In the following exercise you will practice this and notice which amount of stiffness helps you to achieve this aim.

Dynamic Stability and Variability

1. **Testing dynamic stability:** You can experience the previously described principles in standing alignment with the help of a partner. In this exercise you are going to perturb, or push, your partner (safely) while he tries to stay in place and maintain posture. I suggest varying your pushes and surprising your partner in the way you perturb. Your partner will try several strategies to deal with the situation. First your partner tenses all his muscles while you push him. Then your partner keeps all his muscles relaxed as you do the same. Practice until you find the ideal level of muscle preparedness to stay as quiet as possible as your partner pushes you (little postural sway), and notice how long it takes to return to your original position.

   This experience may show you that too much stiffness, in other words, co-contraction of muscles, is not necessarily the best strategy for maintaining alignment. In my experience, tensing all your muscles makes it more challenging to respond elastically to your partner's pushes. The image I use again is the tree in a storm: The one that bends and sways survives; the one that is stiff is most likely to break.

   People with low back pain, for example, actually have increased stiffness in their muscles, so how could it be a good idea to increase the stiffness in a system that is already stiffer than normal? Hodges (2010) maintains that too much stability may increase joint loading and lead to more problems if maintained. The reason for this is that it reduces the ability of the body to absorb forces through movement. Variability is also reduced by too much stability. In other words, when you perform a movement, you never really do it the same way twice. The best approach to motion seems to be the ever-varying one because then your structures, bones, ligaments, joints, and muscles are always exposed to slightly different forces at different angles, pulls, and tugs, and no one element of the system is overused. Trying to make movement too monotone is not healthy (Angier 2010). This has long been known by dancers as movement improvisation, which is a variability practice and leads to better dance technique.

2. **Testing variability:** Start this exercise the same as the previous one. Gently push your partner and notice how long it takes to get back into the original position. Then allow your partner to move for two minutes on his own with as much variability as possible. Your partner should wiggle, shake, rotate, and gyrate his body. Use music if it helps. Avoid repeating movement. Then push your partner again and notice how long it takes for him to recover. In many instances, the reaction time will be slower.

From: Eric Franklin, Dynamic Alignment Through Imagery 2nd Ed.. Human Kinetics, 2012, Champaign: IL