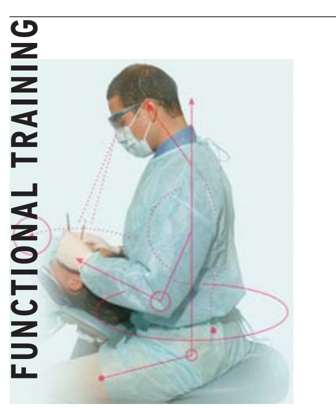

Functional Training for Dentistry: An Exercise Prescription for Dental Health Care Personnel

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ABSTRACT

Athlete's Performance, an organization of specialists in the development of athleticism and injury prevention, has analyzed the seated postural demands of dental health care workers for the purpose of developing an exercise protocol appropriate to the dental profession. As with their individualized exercise prescriptions for some of the world's most acclaimed athletes, the conditioning of the torso is the focus of a prescription for exercise when injury prevention is emphasized. An analysis of the seated postural demands common to dental health care workers is the basis for an exercise protocol intended to strengthen the torso and encourage "good" seated posture.

What do dental health care workers have in common with elite athletes? More than one might think. As dental health care workers, there are enormous physical demands on the back, neck, and shoulders while performing daily work. We must maintain exquisite fine motor control of arms, hands and fingers, while forcefully and continuously recruiting the many muscles required for maintaining a stable working position. Seeking visual access to small and poorly illuminated areas of the oral cavity, dental practice often requires an extreme posture, with numerous spinal articulations placed at the limits of their ability to move. Athletes must also complete their work by moving their hands and arms with great precision from often-

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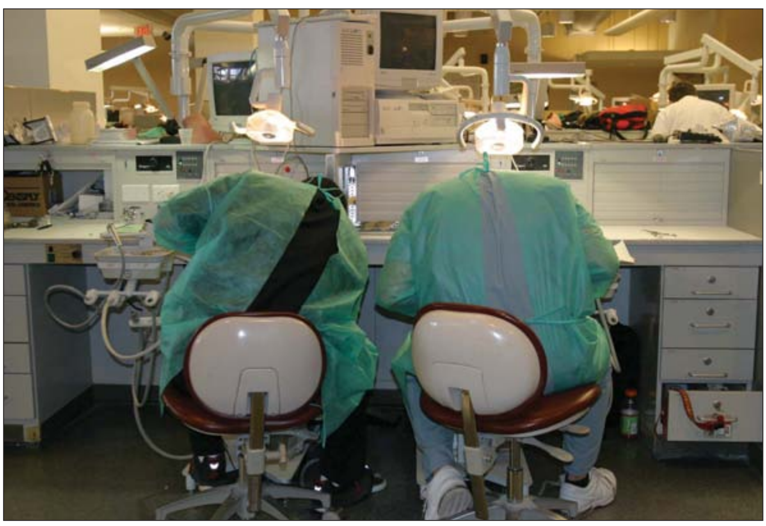


Figure 1. USC School of Dentistry clearly demonstrates poor postural tendencies.

extreme positions. Elite strength and conditioning specialists now emphasize the function of the torso in providing a stable foundation for athletic movement of the extremities.[1] They teach that fitness of the torso is essential to conferring control during athletic movements because the athlete's torso is the biomechanical core from which all controlled movements of the extremities emanate. It is well known that dysfunction of the torso and its spinal elements is not only compromising to the quality of athletic movement, but may ultimately limit the ability of dental health care workers to function professionally.[2-6] The common need for optimal function of the torso, combined with prevention of injury to its supporting structures, unites dental health care workers and professional athletes in common purpose concerning functional torso development. Through the application of concepts developed for the enhancement of athletic torso function, dental health care workers can perform better professionally and be more resistant to injuries in a manner that is exactly the same as professional athletes.

Optimal function of the human torso is developed by exercises that are derived from functional movements. Well-educated athletic trainers are presently teaching such movement in a very popular protocol known as "functional" training.[7] This method of training for athletic movement emphasizes the recruitment of muscles that work in harmony to complete a certain task or movement. Functional training does not seek to isolate muscles in a fashion that is typical of machine-based exercises common to most health clubs. Unlike machine-based exercises, functional training movements require the practitioner to exercise with feet firmly grounded, and the torso unaided in support. Additionally, when performing movements of all types that are intended to enhance the function of the torso, whether seated or standing, the trainee creates a specific postural adjustment of the torso by drawing in the abdominal musculature to narrow the waist and to lengthen the spinal column to its full upright extent. As a result of performing training movements with this drawn in and upright posturing maneuver, these exercises will train the torso to maintain stable upright posture by development of all relevant musculoskeletal and neuromuscular elements through their recruitment with each and every movement. Exercises performed in this manner create optimal posture of the spinal column that are intended to reduce the forces borne by the vertebral disks. This posture-specific exercise tends to foster not only ideal upright posture while training, but also the development of the upright movement of the torso for all functional movement. The ability to achieve stable upright posture through posture-specific training movements bears great relevance to dental practice as it has profound impact on the dental health care worker's ability to resist the negative consequences of leaning forward and rotating to view the oral cavity.

Prolonged postural stress, that so often occurs as a dental health care practitioner leans forward and rotates the head, is especially problematic for the finite supply of connective tissue within the spinal column that invests and supports the skeletal elements of the torso. Chronic excessive loading from this "poor posture" will predictably result in damage to these tissues in many vulnerable practitioners.

Figure 2. This demonstration shows that use of a microscope promotes upright posture of the torso.

Vertebral support, when compromised by the degenerative process, may ultimately fail, leaving the nerve roots that pass through the vertebrae without adequate room for function. The resulting nerve root impingement, or radiculopathy, may disable dental health care workers with back and neck pain, along with dysfunction of the extremities. While dental health care workers struggle for visibility through extreme postural maneuvering, their torsos become a battleground between operator movements to maintain stability and the perturbing force of gravity. As they lean forward and rotate, gravity exerts extreme compressive forces to the spinal column that is borne by connective tissue and resisted by the muscles of the torso. If the muscles that upright this biomechanical core of the torso are not conditioned adequately so as to resist gravity, spinal health may be the casualty of a lengthy battle lost to its inexorable force. The exercises presented in this article are given as an antidote to the negative forces of chronic postural stress that is all too common in dental health care workers.

What's wrong with the posture of dental health care workers? A recent tour of the simulation laboratory of the second-year class at the University of Southern California School of Dentistry clearly demonstrates the postural tendencies induced by the unique challenges of working within the oral cavity (**Figure 1**). Unless one is blessed with the aid of a microscope, as are the selected residents at USC (**Figure 2**), upright posture of the torso is rarely observed in these students. Instead, we see flexion and rotation of the spinal column, along with forward head positioning and internal rotation of the shoulders. Invariably, the weight of the upper body is borne asymmetrically by the seated pelvis with the load of gravity borne asymmetrically by one side of the spinal column. The result of this typical working posture is the most extreme form of biomechanical stress to the vertebral disks of the spinal column.[8] As with the athlete, dental health care workers do not function optimally, nor do they age well, when the joints of the torso are chronically subjected to such an extreme position or "poor posture." This is an orthopedic concept that dentists know intimately as they are experts in the articulation they monitor in every day of clinical dental practice, the temporomandibular joint.

The common need for optimal function of the torso, combined with prevention of injury to its supporting structures, unites dental health care workers and professional athletes in common purpose concerning functional torso development.

The loaded fibrocartilage of the spine — the vertebral disk — like the loaded fibrocartilage of the temporomandibular joint — the articular disk — becomes a source of joint inflammation when subjected to overloading. A joint so afflicted will not only hurt when touched, but the muscles that move it will hurt and persist in a contracted state that will limit movement.[9,10] Temporomandibular joint inflammation will cause muscle contraction that limits jaw opening while vertebral inflammation will initiate a similar process that limits torso movement. If overloading and joint inflammation become chronic, as in the dental patient who is afflicted by malocclusion with bruxism, or the dental health care worker with chronically poor working posture, affected joints may degenerate painfully so as to become the cause of musculoskeletal pain and movement dysfunction of chronic duration. Spinal dysfunction and pain, when viewed in this manner, can be understood as occurring by a process that is similar to the process that affects the temporomandibular joint. Our efforts as dentists to preserve the articular disk of the temporomandibular joint through the creation of a bite that optimizes its position, and by preventing the overloading of parafunction, is the same as the efforts of those who coach athletic movement in preserving the vertebral disks of the spine. "Good" working posture of the athletic spine tends to preserve its connective tissue just as a "good" bite tends to preserve the connective tissue of the temporomandibular joint. The exercises presented herein are intended to preserve the vertebral disks of the spine in a similar fashion to the efforts of dentists to preserve the articular disk of the temporomandibular joint.

Exercise Prescription

Movement Preparation

At the beginning of an exercise program, it is essential to "warm up," that is, to increase the temperature and thus, the pliancy of those tissues about to be stretched and stressed. Since all exercise requires dynamic changes in the length of muscles, their investing connective tissues and articulations, we describe warming up as preparation for movement, or the "movement preparation" phase of our regimen. This phase is also intended to stimulate and prepare the neurological systems that control movement and balance for optimal kinesthetic function. "Movement preparation" prescribed for these purposes is comprised of four elements: (1) increasing

Table 1.1

DYNAMIC FLEXIBILITY

Exercise	How to	Elongation	Activation
Knee hugs	Walking forward, bring one knee to chest and hold. Next, extend to elevate the heel of the down foot.	Maximus of flexed leg	Gluteus maximus of standing leg
Back lunge and twist	Step back and drop back knee straight down. Contract "glute" of back leg and turn towards up knee with arms extended.	Hip flexor	Gluteus maximus
Forward lunge with elbow to instep	Large step forward, keep back leg straight and drop same side elbow to the ground, place hand outside knee and straighten extended leg.	Gluteus maximus, abductors, hip flexors, hamstrings	Gluteus maximus
Leg cradles	Grab knee with same arm and ankle with opposite and lift knee and rotate ankle up toward chest.	Piriformis, hip rotators	Opposite gluteus maximus
Inverted hamstring	Arms up straight out to side of shoulders, turn thumbs toward the back and rotate at the hip pushing heel back, making yourself as long as you can from head to heel.	Hamstring	Opposite gluteus maximus
Lateral squat	Stand with feet double shoulder width, lean and sit hips back behind knee, keeping knee outside of foot and back leg straight. Keep toes forward.	Abductors	Hip abductors

core body temperature; (2) increasing blood flow to working muscles; (3) actively elongating our musculature with safe mobilization of our joints; and (4) activating our nervous system.

To increase the temperature of tissues needed for movement, we rely on the metabolic production of heat along with heat dispersion achieved by perfusion of blood. For this purpose, a short bout of nonstressful movement on an exercise machine is optimal. Five to 10 minutes of biking, elliptical machine, or walking on a treadmill is recommended. This phase should result in a light sweat at its completion. In this warm-up phase, exercises are preferred that subject the body to low impact and thus, low stress during this critical early phase when the body is not prepared for the rigors of athletic movement.

Static stretching (lengthening muscles with externally applied, nonfunctional force while remaining at a given location) is a thing of the past for pre-exercise warm-up routines. The stretching that lengthens muscles and joints well beyond their functional range of motion does not prevent athletic injury and tends to impair balance and muscle function.[11-14] As an alternative to stretching, movement preparation actually improves total body strength and balance. These movements achieve flexibility with a functional movement routine that elongates specific muscles while activating others needed for mobility and stability (**Table 1.1**).

Repeat each of these exercises until stability is achieved. Typically, as you attempt to stand on one foot, you are initially unable to maintain the required posture for more than a few seconds. With repeated efforts, you may become confident in your ability to maintain this posture for a prolonged period. This confident sense of stability heralds the readiness for more demanding movements to follow. Each of the positions described as movement preparation exercises should be maintainable for 30 seconds before the next phase is undertaken.

Neural activation is the final phase of movement preparation. Jumping rope for three 15-second periods, with 30 seconds of rest after each period, is recommended for this endeavor. These exercises will challenge the nervous system such that working muscle connections are ready to train.

Torso Training

As a dental health care worker, the most important component of the training program is torso training. This phase will tend to combat problems that may arise from a "poor" seated posture. "Torso training," frequently referred to as "core training" by fitness professionals, describes the exercises intended for the midsection of the body (the body exclusive of the head, neck, and limbs). For our purposes, the authors separated the torso into three components that confer stability: (1) the shoulders, including the scapulothoracic articulation; (2) the abdominal muscles; and (3) the hips, including all muscles that stabilize the hips in standing or seated position. **Table 1.2** describes a regimen for training your torso effectively and safely.

It is recommended that one consume protein and carbohydrates within the first hour after exercise.

Strength/Resistance Training

Resistance training will increase lean metabolically active tissue and increase total body strength. Selecting exercises can be a complex process as so many choices present themselves to the exercising public. To assist in choosing among the multitude of exercises, the authors offer four groupings of exercises: (1) lower body-push/knee dominant; (2) lower body-pull/hip dominant; (3) upper body push; and (4) upper body pull. A recommended program involves choosing one exercise from each group and doing three to four sets of 10 repetitions two to three times per week. **Table 1.3** lists exercise progressions for each category.

Interval Training

The last phase prescribed in this exercise program is training of the body's energy producing system that oxidizes glucose for the work of movement. Interval training, achieved through bursts of intense exercise with subsequent rest intervals, will increase aerobic capacity; that is, its ability to fully oxidize glucose to carbon dioxide. When oxidation of glucose within muscle cells is incomplete, lactic acid is produced and accumulates within the cellular cytoplasm. This phenomenon degrades muscle function. With increasing aerobic capacity, there is an improved work capacity of the individual. Interval training is intended to develop all of the intracellular mechanisms utilized for producing energy and minimizing the accumulation of lactic acid.

Interval training is the most challenging and yet the most transforming element in this exercise prescription. One must be medically cleared and verifiably capable of enduring the rigors of this physiological stress before undertaking this phase of the exercise prescription. Machines such as the Versa Climber, treadmill, elliptical, Nordic Track, Stairmaster, and others offer excellent options for this type of work. Whichever exercise or exercise machine that is used for this training, the technique is the same; maximal exertion for 10 to 15 seconds followed by resting for

Table 1.2

TORSO TRAINING

Exercise		How to	Purpose
Ys, Ts, Ws, Ls		In prone position with torso supported by physioball, make the letters with your arms by moving from your shoulder blade first. 2x8-15 reps each	Promote scapular stability and prevent rounded shoulder posture
Stick crunch		In hook lying position, place hands or dowel on midthigh, arms extended, draw in abdominals, bring chin to chest, hold this position and try to bring hands or stick over knees. 2x10-15 reps	Promote transverse abdominus, internal oblique, and rectus abdominus strength
Reverse stick crunch		In hook lying position, hold hands or a stick straight above shoulders, draw in abdominals, hold that position and bring heels to butt, lift hips off ground and try to bring knees under the stick. Keep head in contact with the ground. 2x10-15 reps	Promote transverse abdominus, external oblique, and rectus abdominus strength
Seated medicine ball Parallel throws		Sit on a physioball with knees flexed at less than 90 degrees. Face a wall. Draw in abdominals. Coil to the right. Throw and receive the ball while maintaining torso posture. Repeat to the left. 2x10 reps each side	Promote stability of the torso while rotating
Seated medicine ball Perpendicular throws		Sit on a physioball with knees flexed at less than 90 degrees and left shoulder facing the wall. Draw in abdominals. Coil to the right. Throw and receive the ball while maintaining torso posture. Repeat to the left. 2x10 reps each side	Promote stability of the torso while rotating

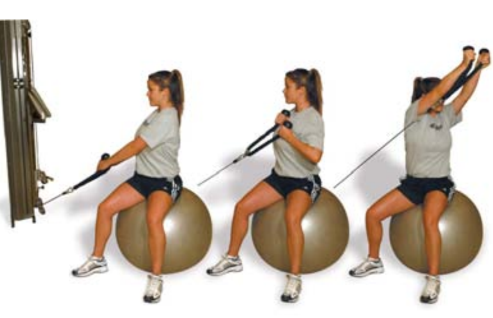
Exercise		How to	Purpose
Side bridge, right and left		Lie on right side with elbow directly under shoulder and feet on top of one another. Draw in abdominals. Keep elevated shoulder back. Squeeze underside hip. Lift and hold for 20 to 30s and repeat on the left side, 2 reps each side	Increase lateral hip stability
"Glute" bridge		Lie on your back with heels only on ground; knees flexed to 90 degrees. Draw in abdominals by pulling belly button to spine. Contract gluteal muscles to lift the hips off the ground. 2x10 reps	
Seated cable chop		With the rope of a cable machine set to its high position, sit on a physioball with shoulder perpendicular to the cable. Grasp rope with both hands while rotating the shoulders to face the cable. Pull to your chest, rotate around to face away from the cable and push away. Repeat on the other side. 2x10 reps each side	Increase rotary strength and stability
Seated cable lift		With the rope of a cable machine in its low position, sit on a physioball with shoulder perpendicular to the cable. Grasp rope with both hands as shoulders rotate to face the cable. Pull to your chest. Rotate to face away from the cable with arm going over the cable. Press away and up. Repeat to the other side. 2x10 reps each side	Increase rotary strength and stability
Seated one-arm cable row		With a handle on cable machine set to its low position, sit on a physioball with shoulders perpendicular to the cable. Rotate shoulders and grasp handle. With inside leg and hip, accelerate cable and rotate through the torso until the handle is on the opposite hip. Repeat to the other side. 2x10 reps each side	Increase rotary strength and stability

Table 1.3

STRENGTH TRAINING

Exercise	Progression			Purpose
Lower body push/knee Dominant exercise Progression	 1. Split squat rear foot elevated	 2. Balance squat		Promote single leg strength and stability without the risk of low back injury
Lower body pull/hip Dominant exercise Progression	 1. Double leg bridge for time	 2. Single leg bridge for repetitions	 3. Physioball bridge with curl	Promote appropriate hip extension using primarily gluteous maximus and secondarily the hamstrings
Upper body push Exercise progression	 1. Incline pushup feet elevated	 2. Alternating incline DB press		Promote chest and shoulder strength while enhancing overall torso and scapular stability
Upper body Pull Exercise progression	 1. Natural grip pull-up/neutral grip pull-down in front	 2. One arm, one leg DB rows		Promote back strength for scapulothoracic and low back stabilization

30 to 45 seconds of recovery. Repeat this process six to 10 times. Progress is made by lengthening the exertion intervals, increasing the number of intervals, or shortening the rest period.

Recovery and Postexercise Nutrition

The low-carbohydrate fad does a great disservice to one's athletic progress. For little more than an hour after intense exercise, muscle tissues are depleted of glucose and in need of amino acids for repair. Insulin and insulin growth factors are essential to this process as these hormones are essential to their transport across cell membranes. After exercise, muscle tissues are grossly depleted of nutrients essential to their restoration and enhancement in adapting to exercise. Immediately following exercise, the rate of uptake of amino acids and glucose is enhanced such that protein synthesis is 350 percent of normal if postexercise carbohydrate and amino acid sources are optimal.[15-17] It is recommended that one consume protein and carbohydrates within the first hour after exercise. This will enhance muscle development and recovery.

Conclusion

Dental health care workers often attempt to gain access to the oral cavity with seated posture that is stressful and potentially harmful to the spine. Especially stressful is that most commonly observed position that is achieved by leaning forward through flexion of the lower back with protrusion of the neck. This posture is additionally made worse by tilting the body to one side while rotating the head toward the patient. Dental health care workers are well known to suffer painful malady of the low back and neck induced by this "poor" posture. Just as a "poor" bite, chronically endured, may cause painful changes in the temporomandibular joint along movement dysfunction of the mandible, chronic "poor" working posture of dental health care workers may cause painful malady and dysfunction of the spine. "Good" posture, like a "good" bite, tends not to create a biomechanical load that is excessive and destructive to the relevant musculoskeletal elements as it places the articular disks in their most favorable load-bearing position. Analogously, positioning the torso to its most upright position is optimal for maintaining spinal health. The muscles of the torso that function against the force of gravity to elevate the spine to its most upright extent can be developed with an exercise protocol described herein. These exercises are a part of the training protocol for injury prevention in some of the world's most elite athletes. They are comprised of functional movements that are performed while seated or standing with feet firmly grounded and the abdomen drawn in. This is believed by expert strength and conditioning specialists to achieve optimal spinal posture during training movements intended to enhance the function of the torso. Through the recruitment of muscles of the torso, "good" posture is reinforced with all dynamic exercises performed in this prescription. In the same manner, recruitment of the torso muscles will encourage "good" posture by the dental health care worker while engaged in the practice of dentistry. CDA

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