Case Study: Needing to Relax

This dog is expressing his interest in something — perhaps a piece of food — by using the neck muscles to tilt its head in an adorable fashion. Humans also sometimes tilt their heads to express interest. But imagine how disturbing and painful it would be if your neck tilted involuntarily, without you being able to control it! Forty-three-year-old Edward, unfortunately, knows just how debilitating this can be.
Edward has a rare condition called cervical dystonia, which is also called spasmodic torticollis. In this condition, the muscles in the neck contract involuntarily, often causing the person’s head to twist to one side. The illustration below shows one type of abnormal head positioning that can be caused by cervical dystonia. The muscles may contract in a sustained fashion, holding the head and neck in one position, or they may spasm repeatedly, causing jerky movements.
of the head and neck.

Cervical dystonia is painful and can significantly interfere with a person’s ability to carry out their usual daily activities. In Edward’s case, he can no longer drive a car, because his uncontrollable head and neck movements and abnormal head positioning prevent him from navigating the road safely. He also has severe neck and shoulder pain much of the time.

Although it can be caused by an injury, there is no known cause of cervical dystonia — and there is also no cure. Fortunately for Edward and other cervical dystonia sufferers, though, there is a treatment that can significantly reduce symptoms in many people. You may be surprised to learn that this treatment is the same substance which, when injected into the face, is used for cosmetic purposes to reduce wrinkles!

The substance is botulinum toxin, one preparation of which may be familiar to you by its brand name — Botox. It is a neurotoxin produced by the bacterium *Clostridium botulinum*, and can cause a life-threatening illness called botulism. However, when injected in very small amounts by a skilled medical professional, botulinum toxins have some safe and effective uses. In addition to cervical dystonia, botulinum toxins can be used to treat other disorders involving the muscular system, such as strabismus (misalignment of the eyes); eye twitches; excessive muscle contraction due to neurological conditions like cerebral palsy; and even overactive bladder.

Botulinum toxin has its effect on the muscular system by inhibiting muscle contractions. When used to treat wrinkles, it relaxes the muscles of the face, lessening the appearance of wrinkles. When used to treat cervical dystonia and other disorders involving excessive muscle contraction, it reduces abnormal contractions.

In this chapter, you will learn about the muscles of the body, how they contract to produce movements and carry out their functions, and some disorders that affect the muscular system. At the end of the chapter, you will find out if botulinum toxin helped relieve Edward’s cervical dystonia, and how this toxin works to inhibit muscle contraction.

**Chapter Overview: Muscular System**

In this chapter, you will learn about the muscular system, which carries out both voluntary body movements and involuntary contractions of internal organs and structures. Specifically, you will learn about:

- The different types of muscle tissue — skeletal, cardiac, and smooth muscle — and their different characteristics and functions
- How muscle cells are specialized to contract and cause voluntary and involuntary movements
- The ways in which muscle contraction is controlled
- How skeletal muscles can grow or shrink, causing changes in strength
- The structure and organization of skeletal muscles — including the different types of muscle fibers — and how actin and myosin filaments move across each other, according to the sliding filament theory, to cause muscle contraction
- Cardiac muscle tissue in the heart that contracts to pump blood through the body
- Smooth muscle tissue that makes up internal organs and structures, such as the digestive system, blood vessels, and uterus
- The physical and mental health benefits of aerobic and anaerobic exercise, such as running and weight lifting
- How individuals vary in their response to exercise.
Disorders of the muscular system, including musculoskeletal disorders (such as strains and carpal tunnel syndrome) and neuromuscular disorders (such as muscular dystrophy, myasthenia gravis, and Parkinson’s disease)

As you read the chapter, think about the following questions:

1. How is the contraction of skeletal muscles controlled?

2. Botulinum toxin works on the cellular and molecular level to inhibit muscle contraction. Based on what you learn about how muscle contraction works, can you think of some ways it could potentially be inhibited?

3. What is one disorder involving a lack of sufficient muscle contraction? Why does it occur?