This report presents the case of a 14-year-old, Caucasian girl who was diagnosed with pectus excavatum (PE) and who underwent an open Ravitch surgical procedure for correction of her chest wall deformity. The Institutional Review Board and patient’s parents granted permission to present this case report. Athletic trainers and therapists who treat adolescent athletes should have a fundamental understanding of the physical manifestations and psychosocial effects of PE. Better understanding may facilitate early identification, prompt referral, and improved care, which may limit adverse psychosocial consequences and optimize outcomes for patients who experience this condition.

Pectus excavatum, also known as “funnel chest,” is a congenital defect of the anterior thoracic wall. The lower costal cartilage undergoes rapid, misdirected growth, which results in a depressed or posteriorly displaced sternum.1-7 The severity of PE is represented by the “Haller Index” (HI), which is also known as the “Pectus Index” (Table 1).2,4,6,7,10 Computed tomography (CT) of the thoracic cavity is performed before and after surgery. The HI is determined by dividing the widest point of the thorax by the shortest anterior/posterior distance from sternum to thoracic vertebra.2,4,6,7,10 The larger the HI, the greater the severity of the PE deformity and patient dissatisfaction with body appearance.7 The results of corrective surgery are immediately identified with CT scans that demonstrate a decrease in HI. Long-term patient satisfaction is good to excellent.4,7,8,11-12

Patients who suffer from PE often have a history of exercise intolerance, dyspnea with exertion, decreased exercise capacity (exercise time, VO2 max, power output, maximum heart rate, anaerobic index), shortness of breath, chest pain or palpitations, low spirometry values, and fatigue.2,4-6,11-13 In addition to physical signs and symptoms,
these patients may also exhibit psychosocial maladjustments, such as anxiety, depression, disturbed body perception, poor body image, low self-confidence, increased interpersonal difficulties, or lack of autonomy.\textsuperscript{2,5,8,11-13} The reported prevalence of PE at birth varies from 1/400\textsuperscript{4} to 1/1000,\textsuperscript{12} but experts agree that it is the most common surgically treated chest condition.\textsuperscript{2,5,5.7,8,11,12} More boys than girls are born with PE (roughly 3:1).\textsuperscript{2,5} Although present at birth, PE becomes more evident with rapid skeletal growth at the onset of puberty.\textsuperscript{4,7}

Pectus excavatum has been identified in skeletal remains of people dating back to the 10th century A.D. The first surgical treatment for the condition was reported in 1911.\textsuperscript{5} A course of external traction for 6 weeks was attempted in 1920 with little success. In the 1950s, Dr. Mark M. Ravitch developed a surgical procedure that involved complete detachment and reattachment of the sternum to the costal cartilage.\textsuperscript{4,5} This procedure was performed on children who were 3–5 years of age from 1953 until the 1990s, but the incidence of restrictive thoracic dystrophy (i.e., failure of the chest to enlarge with general body growth) was troublesome.\textsuperscript{3,8,14} In 1997, Dr. Donald Nuss reported his experience in using a stainless steel strut brace that was inserted into the chest wall, posterior to the malformed sternum, in patients who were 12–18 years of age. Today, the Ravitch or Nuss procedures (also known as the minimally invasive repair of PE, MIRPE)\textsuperscript{4} are commonly accepted surgical methods for treatment of adolescent patients with PE. Although both procedures involve insertion of a stainless steel strut brace into the anterior thoracic cavity, the Nuss procedure is less invasive, because it does not require cartilage resection or sternal osteotomy.\textsuperscript{2,5,7,10} Flexible cartilage and elasticity of the thoracic wall make teenage patients good candidates for repair of PE deformity.\textsuperscript{15,14}

Post-surgical recommendations include a 3- to 5-day hospital stay,\textsuperscript{12-14} followed by 3 weeks of recovery at home. Light exercise or lifting may begin 1 month after surgery,\textsuperscript{12} light lifting after 2 months,\textsuperscript{8} and return to noncontact activities after 3 months.\textsuperscript{12,15} The length of time for the stainless steel strut brace to remain in place ranges from 2 to 4 years.\textsuperscript{4,12-14}

Although PE is present from birth, many patients do not notice or express concern about the deformity until their early teenage years. Many pediatricians consider corrective surgery as cosmetic in nature;\textsuperscript{4,10} however, as the patient develops, a number of factors should be considered. An adolescent growth spurt that exacerbates the condition is a common reason for development of concern, but some attribute it to psychosocial factors, i.e., development of identity, independence, self-confidence, positive body image, and the need to be accepted by peers.\textsuperscript{2,4,5,7-10,12} Positive physical and psychosocial results of the corrective surgery include improved pulmonary function,\textsuperscript{4,5} increased exercise capacity,\textsuperscript{4} and improvements in body image, self-esteem, quality of life, and ability to deal with social problems.\textsuperscript{7,8,12}

**Case Review**

A healthy 14-year-old Caucasian female who had been diagnosed with PE as an infant underwent a Ravitch procedure to correct her chest wall deformity. She was born with a mild PE, which increased in severity as a result of a rapid growth spurt at puberty. Prior to surgery, the patient participated in a variety of physical activities, but was often fatigued or short of breath shortly after initiation of activity. The patient and her mother consulted a pediatrician who referred them to a pediatric cardiothoracic surgeon to discuss options for PE corrective surgery. After the surgeon described the surgery and follow-up procedures, the patient and her parents elected to have the surgery performed. A week prior to the surgery, anterior-posterior and lateral view radiographs were obtained to rule out underlying conditions that could complicate the surgery. A radiologist confirmed the PE deformity with no other abnormalities of the ribs, lungs, heart, or abdomen.

The surgeon performed a modified Ravitch procedure with an infra-mammary incision, through which he inserted a 7-inch Lorenz stainless steel strut brace. Prior to inserting the Lorenz brace, he elevated the pectoralis major muscles and detached the rectus abdominis from its origin on the xiphoid process. The xiphoid process and bilateral costal cartilage from ribs 4-8 were then removed, and an anterior sternal osteotomy was performed. The Lorenz brace was inserted into the thoracic cavity and was secured with two stainless steel wires. The pectoralis major and rectus abdominis muscles were reattached and the subcutaneous tissue was sutured in layers. Standard postsurgical radiographs confirmed that the Lorenz bar and stabilizing wires were properly positioned, but they also identified a small (6mm) right apical pneumothorax. Photographs taken before and after surgery (Figures 1