FLEX CEUs

Ehlers-Danlos Syndromes: Physical Therapy Considerations

FLEX CEUS
FlexTherapistCEUs.com

FLEX CEUs
FlexTherapistCEUs.com

Introduction

Ehlers Danlos Syndrome (EDS) represents a variety of disorders affecting connective tissue throughout the body. Connective tissue is unable to form correctly due to genetic variance in the proteins and genes that produce collagen. EDS has several types with a distinct clinical presentation for each type. The most common characteristics are joint hypermobility, joint and muscle pain, laxity in the skin, and recurrent joint dislocations. EDS as a whole is a relatively common disorder, but each subtype can be quite rare. Physical Therapists and Physical Therapist Assistants need to understand the clinical presentation and symptoms patients experience when referred to other providers, and how to intervene and support patients with Ehlers Danlos Syndrome.

Section 1

EDS is a disorder of collagen and impacts nearly every system in the body. This section will outline how common EDS is, clinical presentation, causes of EDS, and describe the thirteen types of EDS. It is important for all clinicians who may encounter and treat patients with EDS to understand the disorder and clinical presentation as a whole.

FLEX CEUS
FlexTherapistCEUs.com

Overview [1–3]

Ehlers Danlos Syndrome is a term encompassing a range of disorders of human connective tissue. There are several types and forms based on how genetic mutations in respective genes impact the development of connective tissue across the body. Collagen is the prominent protein in the body that is affected by EDS. Collagen exists in nearly every bodily system acting as supportive connective tissue and organ components of bone, cartilage skin, tendons, and ligaments. There are a few types of collagen in the body, including types 1, 2, 3, and 4. Type 1 collagen is found predominantly in tendons, bones, and organs and is responsible for providing structural support to the connective tissue in these areas. Type 2 collagen is found in cartilage and provides support to cartilage. Type 3 collagen is found mostly in connective tissue. Type 4 collagen comprises the deepest layer of the cell membrane that separates connective tissue from skin cells. Type 1 collagen is typically negatively impacted by EDS more often than other types of collagen. Type 1 collagen abnormalities are due to genetic mutations in the genes that code for or support the function and structure of type 1 collagen.

Prevalence

Among all EDS types, the incidence is just around one in 3700 people. With the hypermobility subtype prevalence is one in 12,500 people. The classical subtype is observed in 1 in 30,000 people. The vascular subtype occurs in just one in 250,000 people. The rarest subtypes, including kyphoscoliosis and dermatosparaxis, represent around 45 documented cases worldwide at a time. Ehlers Danlos Syndrome affects females and males and all racial and ethnic groups equally.

Etiology [4]

Ehlers Danlos syndromes are caused by specific mutations in nearly twenty genes that produce or support the production of collagen. These genes include COL5A1, COL3A1, TNXB, PLOD1, FKBP14, and others. Most are inherited disorders and lead to poor function, structure, and production of collagen, weakening the connective tissue within organs, muscles, bones, tendons, and ligaments.

Some comorbidities are associated with EDS. Patients may have scoliosis and kyphosis in the spine, creating the potential for pain and poor function. Patients may also have osteoporosis as it is common among people with EDS. Due to instability near the cervical spine, patients may have recurrent headaches and migraines. It is common for patients with EDS to experience chronic pain, chronic fatigue, and heightened pain response to a small stimulus. Patients may have cardiac valve disorders, endocarditis, and dilation of major vessels. In the gastrointestinal system, nearly half of people with EDS have gastroesophageal reflux and irritable bowel syndrome. It is common to have gingivitis, bruising, depression, anxiety, and dysautonomia. Dysautonomia means the autonomic nervous system is not working correctly and symptoms could be anxiety, heart rate and respiration abnormalities, and fatigue.

Clinical Presentation Across the Lifespan [5]

Life span can be shortened with the vascular subtype largely as a result of the failure of vessels and circulation. This is not true with most other types of EDS as life expectancy is not affected. Hypermobile EDS is the most common type of EDS, and therefore the most commonly encountered by therapists. In children, patients with EDS will display a certain clinical presentation. Children with the hypermobile subtype present with joint and

muscle pain and joint dislocations. This is due to the poor stability of joints putting overload on supporting muscles and joints. Just over eighty percent of children report pain within a day after exercising, which most often occurs in the knee and shoulder. Children with EDS will typically have a lower level of fitness compared to control groups largely due to pain with exercise. Children within their first and the beginning of their second decade of life will report poor quality of life compared to their peers due to fatigue, pain, and occasional incontinence.

Patients and children with the kyphoscoliotic, arthrochalasia, spondylodysplastic, myopathic, and musculocontractural EDS types will present with notable characteristics described in the next section from birth and into childhood. Children and adolescents with EDS may also present with hyporeflexia or absent deep tendon reflexes, poor balance, and muscle weakness compared to their peers. Children may report digestive issues and develop gastrointestinal reflux, constipation, and diarrhea. From a developmental standpoint, children will be behind in milestones such as walking and jumping and they may fall more easily than their peers without EDS. Children are at risk for low self-esteem and depression due to feeling different than their friends.

Adults will present with joint pain with a heightened pain response due to an overactive nervous system. Adults will also experience chronic fatigue and pain, anxiety, depression, and digestive problems at higher rates than people without EDS. Muscle weakness is also a common presentation that carries on from childhood, along with poor balance. Fall risk is very high among adults with EDS, as studies demonstrate that over 95 percent of adults with EDS fall at least once per year. Adults often present with dysautonomia related to the cardiovascular system, where the autonomic nervous system functions poorly. Incontinence has a rate of nearly 75 percent in women with EDS.

Types of Ehlers Danlos Syndrome [4,6–11]

There are thirteen types of EDS according to the 2017 classification system for Ehlers Danlos Syndrome. Types are differentiated based on genetic variations and clinical signs and symptoms, such as hypermobile joints and fragile skin. EDS ranges from life-threatening to mild presentation. This section will discuss the thirteen classifications of EDS and comment on clinical presentation, genetics, and clinical presentation. The most common type of EDS is called hypermobile syndrome and amongst the least common syndromes are periodontal, spondylodysplastic, and brittle cornea syndrome.

Hypermobile EDS

Hypermobile EDS is the most common type of EDS and the most common disorder of connective tissue as a result of genetics. Hypermobile EDS is inherited as an autosomal dominant trait. This means that one parent must exhibit the disease, giving the child a 50 percent chance of inheritance. Diagnosis of hypermobile EDS is based on clinical presentation as there is no hereditary test for etiology yet identified. Diagnosis is made by excluding other possible connective tissue disorders and by a few clinical characteristics. These are having hypermobile joints and either a family history of connective tissue disorders, problems with the musculoskeletal system, or systemic evidence proving that a more life-threatening connective tissue disorder is not present. To be diagnosed with hypermobile EDS a person also cannot have clinical signs of skin breaking, and signs or diagnosis of other genetic connective tissue and rheumatic disorders.

Many common correlated conditions may present in people with hypermobile EDS. These include problems with sleep, increased fatigue, postural orthostatic tachycardia syndrome (POTS), digestion problems, anxiety, and depression.

FLEX CEUS
Flex-Therapists-CEUs.com

Classical EDS

Classical EDS represents one of the thirteen types of EDS. It typically results from genetic variance in the COL5A1, COL5A2, or COL1A1 genes. These genes are important for making collagen, the main protein in connective tissue. Classical EDS is inherited through an autosomal dominant trait, where one parent must exhibit the trait. Diagnosis of classical EDS is typically started with a clinical physical examination searching for hypermobility in joints but is confirmed by genetic testing for mutations in the genes listed above. People with classical EDS will exhibit several characteristics. The most common characteristics are increased extensibility of the skin and scars that heal at a deeper layer of skin than normal (atrophic scarring). Skin is considered overly extensible; it is possible to stretch the skin by 0.6 inches at the distal forearm and back of the hand, 1.2 inches at the neck, elbow, and knees, and 0.4 inches at the palm.

Classical-Like EDS

Classical-like EDS differs from classical EDS in that it is caused by a mutation in the TNXB gene which supports collagen function rather than contributing directly to creating collagen. Classical-like EDS can also be caused by gene deletion of the TNXB and

CYP21A2 genes. When the CYP21A2 gene is affected, it is common to see adrenal hyperplasia and therefore impaired release of hormones such as cortisol, norepinephrine, and epinephrine from the adrenal glands. People inherit classical-like EDS by an autosomal recessive process, in which both parents must carry the mutated gene to pass it on to the child. The child will then have a 25 percent chance of having classical-like EDS. This may be unexpected as the parents who carry the recessive gene may not exhibit symptoms of classical-like EDS themselves. They may have subtle signs such as some hypermobile joints. Diagnosis of classical-like EDS is made based on a clinical physical examination searching for hypermobility in joints but is confirmed by genetic testing for mutations in the genes listed above.

People with classical and classical-like EDS exhibit hypermobility in their joints and have skin fragility. They may more easily get bruises and not heal efficiently from scrapes and cuts. People with classical EDS are predisposed to hypotonia or low tone in muscles. This will likely delay the progression of motor skills as an infant and in early childhood. People with these types of EDS are predisposed to heart problems from poor tissue strength in the valves and chambers of the heart.

FLEX CEUs
FlexTherapyCEUs.com

Cardiac-Valvular EDS

Cardiac-valvular EDS is a rare type of EDS and manifests with serious complications. The exact prevalence is not well estimated. People with this type of EDS will often have a complication in their first few decades of life. This is due to the weakening of the aortic and mitral valves in the heart. Like the other types of EDS, patients have atrophic scars, develop bruises easily, and have excessively mobile skin. Many patients with this type of EDS will require valve replacement surgery at some point in adulthood. Cardiac-valvular EDS should be differentially diagnosed from hypermobile EDS and classical EDS based on cardiac testing and molecular testing of gene expression.

Cardiac-valvular EDS is transmitted autosomal recessively. It is diagnosed with clinical characteristics noted above and confirmed with testing for the missing proa2-chain component of Type 1 collagen due to a mutation in the COL1A2 gene.

Vascular EDS

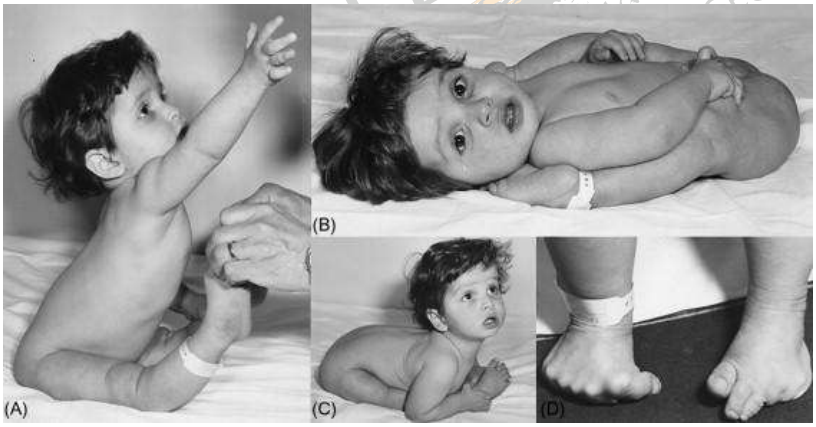
Vascular EDS is among the rare types of the disease and is considered the most life-threatening type. People with vascular EDS will have fragility in vasculature throughout the body. This means that vessels anywhere in the body are at risk of tearing or

ballooning, putting the patient at risk of life-threatening bleeding. Vascular EDS also increases bruising risk, creates fragile, thin skin, increases the risk for the rupture of organs due to weakness in this connective tissue, and increases late-term tearing of the uterus in pregnancy. It is often characterized by increased mobility in the digits of the hands and feet and small noses, small lips, larger eyes, and small earlobes.

Diagnosis of vascular EDS requires knowledge of several criteria. These include a mutation in the COL3A1, genetic inheritance by autosomal dominance, rupture of an artery, colon rupture, uterine rupture during late pregnancy, and formation of a fistula in the carotid artery. Most patients with vascular Ehlers Danlos Syndrome will have a serious health complication by the fourth decade of life.

Arthrochalasia EDS

Patients with arthrochalasia EDS will demonstrate hip dislocation from birth, extreme joint hypermobility, low muscle tone, and excess skin elasticity. Diagnosis is first suspected by these clinical characteristics and confirmed by molecular testing. The genes COL1A1 or COL1A2 are typically mutated which causes loss of production of type 1 collagen. This is inherited through autosomal dominance. Less than one hundred cases of arthrochalasia EDS have been reported in the literature to date.



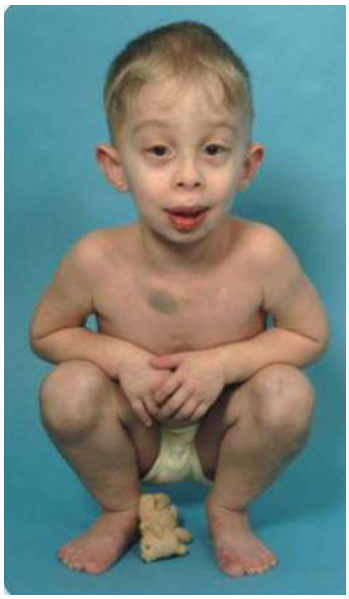
https://www.sciencedirect.com/science/article/pii/B978012397165400023X

Dermatosparaxis EDS

People with dermatosparaxis EDS exhibit fragile and excessive skin, a high incidence of hernias, and excess joint laxity. Patients suffer from repeated joint dislocations and severe bruising. This type of EDS is incredibly rare, with under ten cases reported. Dermatosparaxis EDS occurs due to a gene mutation in the ADAMTS2 gene. In normal

cases, this gene acts as an enzyme to assist in developing collagen into a mature form. It is inherited through an autosomal recessive process.

This type of EDS is diagnosed based on physical examination for joint laxity and common characteristics and confirmed with a genetic test.

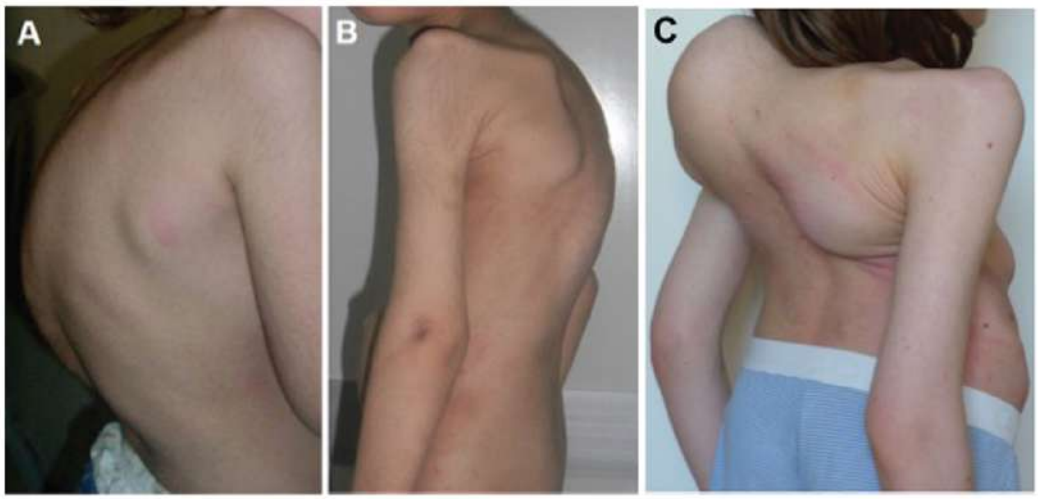


https://slideplayer.com/slide/5850676/

Kyphoscoliotic EDS

This type of EDS is characterized by low muscle tone from birth on and frequent hip, knee, and shoulder dislocation and hypermobility. Patients will also exhibit kyphoscoliosis which begins at birth or shortly after birth and either remains the same or progresses over time. Patients will additionally have soft skin with increased laxity and fragile eyes. Diagnosis will be made by acknowledging the above characteristics and a genetic test. Patients will have mutations on the gene PLOD1, meaning the creation of lysine and protein is disrupted. It is passed from parents to a child in an autosomal recessive pattern.

Kyphoscoliotic EDS has an incidence of 1 in 100,000 births. Complications of the vascular system such as vessel rupture have also been reported due to fragility in vessels. Patients are at a risk for decreased life span due to weakness in vessels and potential for complications such as lung compromise due to kyphoscoliosis.

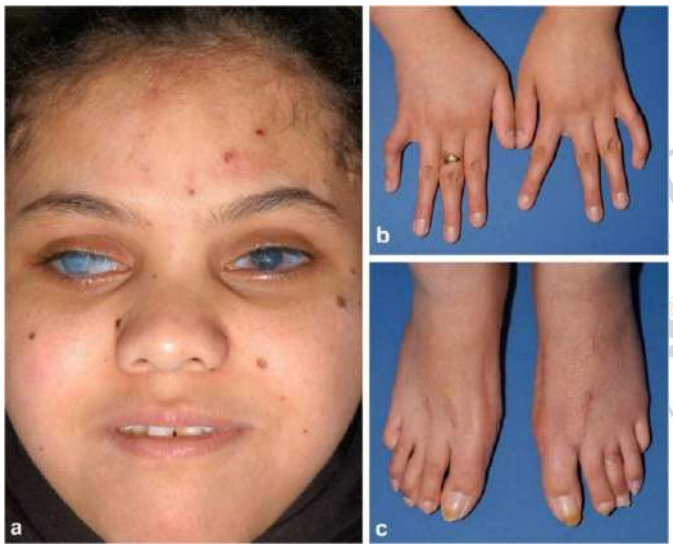


FLEX CEUs
Flex Therapists CEUs.com

Brittle Cornea Syndrome

Patients with brittle cornea syndrome exhibit an increased risk of rupturing their cornea due to fragility, blue sclerae, and progressive keratoconus and keratoglobus. Damage to the cornea can occur randomly or with a small trauma. When a corneal tear is severe enough, the ocular rupture will occur, which means a person is irreversibly blind. It is also somewhat common for patients with brittle cornea syndrome to experience hearing loss as well. Patients may also experience skin fragility, kyphoscoliosis, joint laxity, and joint dislocations as in other types of EDS.

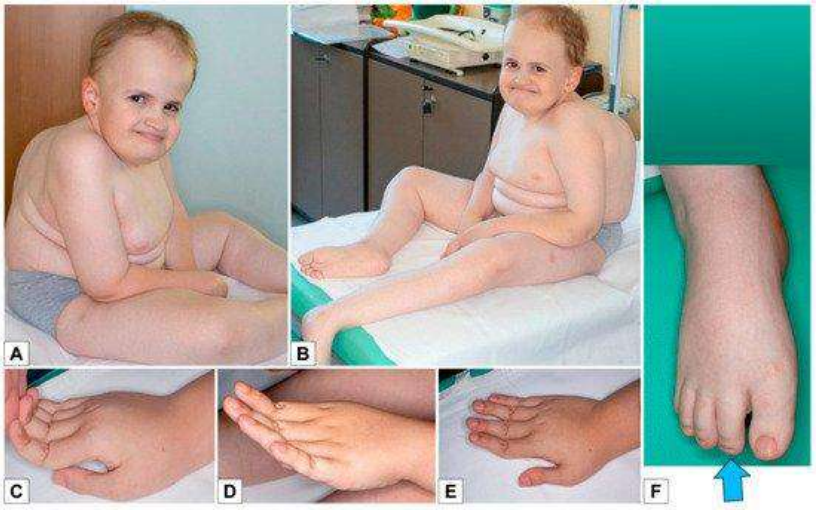
This type of EDS is caused by mutations in the ZNF469 or PRDM5 gene and is inherited in an autosomal recessive manner.



https://ojrd.biomedcentral.com/articles/10.1186/1750-1172-8-68

Spondylodysplastic EDS

This type of EDS is characterized by short height which worsens as a child ages, muscle hypotonia ranging in severity, limb bowing or varus, and intellectual disability. Patients often display eyes that are widely spread out, a triangle-shaped face, a wide forehead, blue sclerae, a narrow mouth, and a small jaw.

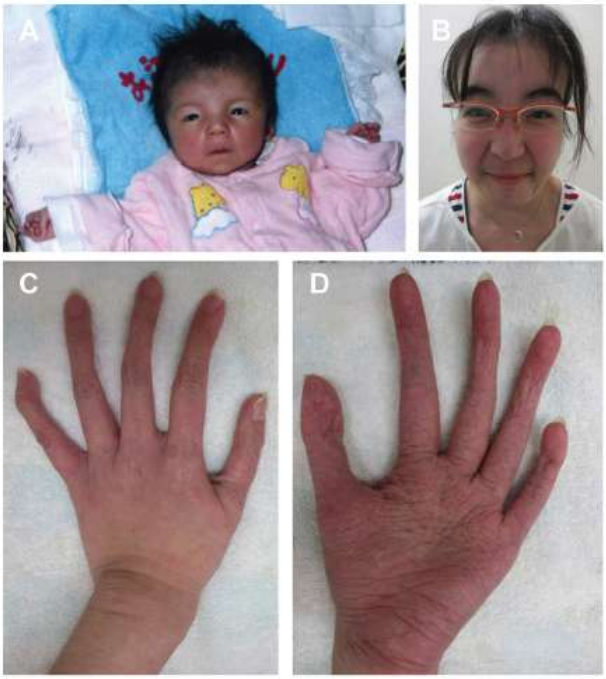


https://www.mdpi.com/2073-4425/10/10/799

Patients will have increased joint mobility, pes planus, contractures in the elbow, osteopenia, and long digits of the hands.

Diagnosis relies on confirmation through genetic testing of mutations in the B4BALT7, B3GALT6, and the SLC39A13 genes. Spondylodysplastic EDS is passed down from parents to children in an autosomal recessive pattern.

Musculocontractural EDS



This type of EDS is characterized by several contractures at birth, especially of adductors and flexors in the thumbs and other areas throughout the body, talipes equinovarus (clubfoot), increased skin laxity, extremely wrinkled palms, increased severity of bruising, atrophic scars, and features of the craniofacial region. Some craniofacial features of Musculocontractural EDS include blue sclerae, a short nose, inferior and posteriorly positioned ears, thin upper lip, a small mouth, a narrow face, and a prominent jaw. Patients of this type of EDS may suffer from hematomas, congenital heart defects, and valve abnormalities.

Musculocontractural EDS is a result of mutations to the gene CHST14 and is inherited in an autosomal recessive manner. It affects less than one in one million people in the world at birth.

Myopathic EDS

Myopathic EDS is characterized by muscle hypotonia acquired at birth, atrophy, myopathy, contractures that occur in the knee, hip, and elbow, and increased mobility of joints distally. The hypotonia and atrophy at birth typically improve after birth until the patient reaches a few decades of life. Patients may have poor facial symmetry, a short nose, large ears, and kyphosis.

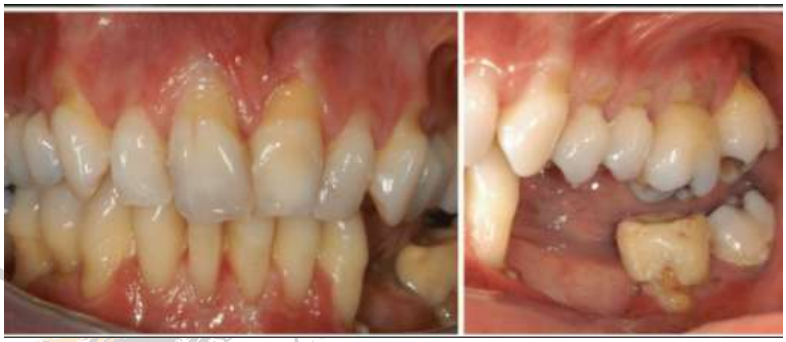
Myopathic EDS is confirmed by molecular genetic testing. The gene COL12A1 is typically mutated and passed down in either an autosomal dominant or an autosomal recessive

pattern. This gene allows the connection between type 1 collagen fibers and adjacent structures that support collagen. The COL12A1 gene is also responsible for the production of type seven collagen found in skeletal muscle.

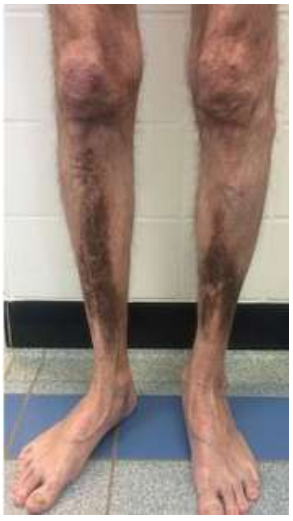
Periodontal EDS

This type of rare EDS is characterized by periodontitis that suddenly occurs before adulthood, gingiva that becomes detached, pretibial plaques, and family history of a person with related symptoms. The risk of periodontitis being severe inflammation of the supportive tissue of the teeth is the deterioration of teeth and tooth loss. Nearly half of patients with periodontal EDS will have joint hypermobility as well and have lesions on the pretibial region as depicted below.

Periodontal EDS is confirmed by molecular testing of C1R and the C1S genes and is inherited through autosomal dominance.



https://link.springer.com/article/10.1007/s10048-018-0560-x



https://twitter.com/vasculomet_med/status/1043624047085522944

FLEX
FlexTherapistCEUs

Section 1 Summary

As discussed in this section, Ehlers Danlos Syndrome has a varied clinical presentation and affects the lifespan differently depending on the type of EDS. The more common types of EDS are the hypermobile and classical types which present with joint laxity, pain, skin fragility, and weakness. The rare types of EDS such as vascular and dermatosparaxis tend to be more severe in risks and complications. It is important for all clinicians who encounter patients with EDS to understand the disorder to best manage these patients.

Section 1 Key Words

Autosomal Dominant Inheritance – refers to a hereditary disorder which is inherited by one parent having gene expression of the disorder and the child being 50% likely to also acquire the disorder

Autosomal Recessive Inheritance – refers to a hereditary disorder that is inherited by both typically asymptomatic parents passing on a mutated gene and the child expressing the disorder

FLEX CEUS
FlexTherapistCEUs.com

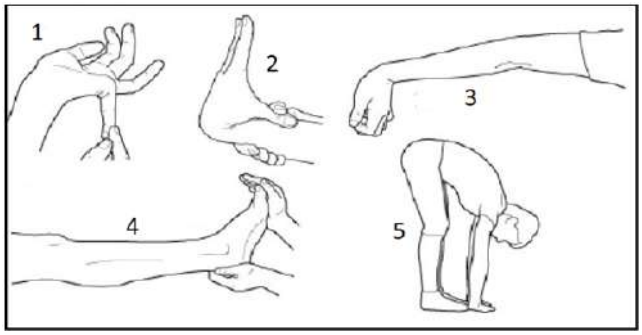
Section 2

As clinicians who treat Ehlers Danlos Syndrome, it is important for Physical Therapists and Physical Therapist Assistants to understand the medical diagnosis, typical treatment, and complications of the disease. Clinicians should be well versed in the scope of other professionals and collaborate in treatment for the best care of people with EDS.

Medical Diagnosis [12–14]

Medical diagnosis depends on physical examination with clinical characteristics described in detail in the types of EDS section above. Part of that examination is the Beighton scale to determine joint hypermobility. The other part of diagnosis is genetic testing to determine gene mutations involved in collagen production for each type of Ehlers Danlos Syndrome.

The Beighton Scale



The Beighton scale is an important diagnostic tool that detects joint hypermobility based on the assessment of five movements. Healthcare professionals including physical therapists should be aware of the Beighton scale and how to administer it to screen for and assist in the diagnosis of conditions associated with joint laxity. The Beighton score has been used globally to describe joint mobility in various age groups and populations. It was further investigated in 1969 to assess joint hypermobility in the Ehlers Danlos Syndrome population. The Beighton scale investigates four passive maneuvers and one active maneuver. The passive maneuvers include an extension of the fifth metacarpophalangeal joint beyond 90 degrees, thumb opposition to the medial aspect of the forearm, elbow hyperextension past ten degrees, and knee hyperextension past ten degrees. The active maneuver involves the patient standing and flexing the trunk anteriorly with knee extension and putting their palms on the floor. The first four test items are scored based on examining bilaterally (left and right) and given one point if the test meets the criteria outlined above. The active maneuver of forward trunk flexion is scored out of one possible point. This brings the total of the Beighton scale to nine points. If someone has a score of four or greater out of nine, they have joint hypermobility and laxity in their ligaments. A score of three or under indicates normal ligament laxity. A score of greater than six out of nine is used in children due to increased joint laxity when compared to adults.

Reliability has been examined for the Beighton scale in terms of consistently measuring joint laxity and the ability of examiners to be consistent using the scale. Interrater reliability is very high among qualified professionals, reported being a 0.85 intra-class correlation coefficient (ICC) or greater. Intrarater reliability for the Beighton scale is also very good to excellent as most studies list the ICC at 0.89 or greater. Qualified professionals include healthcare professionals such as Physical Therapists, orthopedic surgeons, and rheumatologists.

Validity represents the accuracy of a test. The Beighton scale is a valid measurement for joint hypermobility as long as a goniometer is used for exact joint measurements. This is especially true with adults and children from six to twelve years old.

FLEXCEDS
FlexTherapistCEUs.com

The Beighton scale is a quick and efficient tool to determine joint laxity. However, it does have some drawbacks. A person may have a connective tissue disorder such as EDS which affects joints other than the ones tested in the Beighton scale. The scale is also either positive or negative for joint hypermobility. This leaves no room to indicate the severity of laxity or the most hypermobile areas of the body. Another measure of joint laxity is called the Hospital Del Mar criteria. The Hospital Del Mar criteria test laxity in the thumb, metacarpophalangeal joint, elbow, shoulder, hip, patella, ankle, foot, knee, and bruise severity. It is considered reliable and valid among qualified professionals and more comprehensively assesses laxity than the Beighton scale. This joint laxity measure does need to be validated with specific diagnoses, including Ehlers Danlos Syndrome.

	LEFT	RIGHT
1. Passive dorsiflexion and hyperextension of the fifth MCP joint beyond 90°	1	1
2. Passive apposition of the thumb to the flexor aspect of the forearm	1	1
3. Passive hyperextension of the elbow beyond 10°	1	1
4. Passive hyperextension of the knee beyond 10°	1	1
5. Active forward flexion of the trunk with the knees fully extended so that the palms of the hands rest flat on the floor	1	1
TOTAL		/9

FlexTherapistCE

https://www.physio-pedia.com/Beighton_score#cite_note-Alter-6

Complications of Ehlers Danlos Syndrome [2,15–18]

As described briefly in an earlier section, there are severe complications associated with Ehlers Danlos Syndrome. Vascular and kyphoscoliotic types of EDS have the highest rate of these complications although they do happen in all types at lesser rates. Complications are found throughout the body as collagen is present in most supportive and structural systemic connective tissue. The most common complications are of the cardiovascular, gastrointestinal, urinary, musculoskeletal, and reproductive systems. There are also common psychosocial and psychological implications of the disease. These will be discussed below. The complications outlined in this section make it clear why providers treating patients with EDS need to be advocating for preventative medicine and educating on risk factors.

Cardiovascular Complications

Cardiovascular problems are among the most severe complications associated with Ehlers Danlos Syndrome. Typically, these are most associated with the vascular and kyphoscoliotic types of EDS due to the weakening of the membranes and collagen surrounding vasculature. Unfortunately, it is relatively common for people with vascular EDS to suffer from a rupture or aneurysm of an artery in the body in their lifetime. These ruptures occur most frequently in the thoracic or abdominal cavity and can be life-threatening when they occur in major vessels, such as the thoracic or abdominal aorta. Approximately 70% of patients with vascular EDS will sustain an arterial or organ rupture before or during their fourth decade of life. Another cardiovascular complication is cardiac valve problems. Patients with cardiac-valvular and vascular EDS are at risk of mitral and aortic valve prolapse and regurgitation. Valve prolapse occurs when the valve components bulge into the atria. Regurgitation occurs when blood flows from the ventricle to the atrium backward. If these occur at the left side of the heart between the atria and ventricle, the mitral valve is involved. If this occurs at the right side of the heart between the atria and ventricle, the tricuspid valve is involved. The aortic valve is involved if this occurs between the left ventricle and aorta and the pulmonic valve is affected if it occurs between the right atrium and pulmonary artery. Patients with valve prolapse and regurgitation need the surgical intervention of valve repair or valve replacement if it Is severe enough. Patients may also form a carotid-cavernous sinus fistula without any precipitating event. This occurs in the brain after a small tear in the carotid artery which develops a poor connection from the venous cavernous sinus to the internal and external carotid artery. Symptoms of this are edema near the eye, pain, headache, irritation, and extraocular muscle palsy. When left untreated, a patient could have permanent vision loss.

Gastrointestinal

Gastrointestinal organ ruptures are another common complication of specifically vascular and kyphoscoliotic EDS. Organ rupture does occur in other types of EDS but at an infrequent rate. Organ ruptures occur typically in the sigmoid colon, spleen, liver, and uterus. Ruptures occur due to the malformation of type 3 collagen surrounding intestinal walls. Patients are at risk of organ rupture during their fourth decade of life or earlier, as 70% of people with EDS do sustain a vascular or organ rupture. This reiterates the need for early and often education for patients with vascular and kyphoscoliotic EDS types to avoid strenuous activity including contact sports and weightlifting. Patients who need surgery on perforated organs have high rates of complications due to poor wound

healing associated with the lack of appropriate collagen. Surgeons will often only perform abdominal surgeries when it is necessary or urgent to avoid life-threatening complications.

Psychological

Patients with EDS experience higher rates of some mental health disorders than the general public. It is common for patients to have depression, anxiety, and some mood disorders. Patients may also experience somatoform disorders where a psychological stressor or event causes physical symptoms of pain. The most likely precipitator for mental health disorders like anxiety and depression is pain and uncertainty about future health. Patients report being nervous about sustaining complications like joint dislocations and systemic organ or arterial perforations. Many patients with EDS experience chronic pain and chronic fatigue which worsens sleep quality and increases stress levels. The most common types of EDS, hypermobile and classical, have a rate of near 45% for anxiety and/or depression.

FLEX CEUS
FlexTherapistCEUs.com

Urinary

The pelvic floor and urinary system are made of many different types of collagen. Therefore having EDS predisposes the area to weakening and poor function. Patients report high rates of urge and stress incontinence and incontinence while sleeping. Other complications are frequent urinary tract infections, bladder obstruction, urinary retention, and pain.

Reproductive

Women with the hypermobile types of EDS are at risk of several problems in the reproductive system. These include uterine prolapse, irregular menstruation, failure of the ovaries, polycystic ovary syndrome, endometriosis, polyps in the ovaries and uterus, and poor function of the pelvic floor. During pregnancy and labor, women with EDS are at increased risk of having birth preterm, dislocating pelvic structures such as the pubic symphysis and the coccyx, sustaining extreme pelvic floor tearing, and poorly healing wounds from c-sections. After having birth, women with EDS often have more severe joint instability and laxity than before becoming pregnant, resulting in pelvic and spinal pain and risk for injury.

Prognosis [2,19,20]

The prognosis of Ehlers Danlos Syndrome is dependent on the type of EDS, comorbidities, and complications associated with it. Most types of EDS do not affect life expectancy. However, any type of EDS which affects joint mobility may increase musculoskeletal symptoms like joint and muscle pain and joint dislocations which can impact the quality of life. Patients with most types of EDS also are subject to higher rates and severity of bruising and skin fragility. This means that injuries and accidents are typically more serious for people with EDS. If patients with most types of EDS are well educated early on about injury avoidance, joint health, and prevention, they may be able to live without any complications.

Vascular EDS has the worst prognosis amongst types of EDS due to vascular complications. Patients with vascular EDS have an average life expectancy of 48 years old. This is due to the risk of aneurysm and vessel rupture from weakened systemic vessels. Kyphoscoliotic EDS where patients have kyphosis and scoliosis in their spine can also reduce life expectancy depending on the severity of this curvature. This is due to the risk of vascular complications and lung compromise from reduced space in the thoracic cavity.

There can be a large psychosocial impact of having Ehlers Danlos Syndrome. Due to the lack of visible problems with mild types of EDS, some patients feel unheard by providers and lose faith in healthcare. This can lead to a delay or complete avoidance of care for general health concerns. Patients may also be frustrated or disappointed due to EDS having no cure. All clinicians need to screen for mental health concerns in patients with EDS and refer to the appropriate provider if screening comes back positive.

Medical Treatment [2,21]

Treatment for Ehlers Danlos Syndrome follows a multidisciplinary approach. Each health care professional caring for someone with EDS should be aware of complications and ho w comorbidities impact people with EDS. The general goal of medical treatment of EDS is to prevent any worsening symptoms and problems that the disease may cause. The re is no cure for EDS, so treatment focuses on the prevention of complications and symptom improvement if complications do occur. Patients with EDS typically have a primary care physician and possibly a geneticist to assess and treat all general health concerns, diagnose the patient, and make referrals as needed. Physicians who specialize

FLEX CEUS
flextherapyCEUs.com

in certain disciplines will be involved if there is a concern for complications. For example, a patient with vascular EDS will have a cardiologist to monitor vasculature and cardiac comorbidities and complications. If a patient's joint hypermobility is severe enough and causes a dislocation, an orthopedist will be involved. Prevention focuses on screening and education. Medical providers should encourage physical examinations at regular intervals to monitor for general health. Patients should have regular cardiovascular screening to ensure the health of the valves and vasculature that comprise the heart as these areas can be fragile with vascular EDS especially. Patients should be instructed to avoid activities that put their joints at risk of dislocation such as lifting heavy weights and sports where falling is a high risk, such as skiing. Patients who become pregnant should always be referred to an Obstetrician who is highly competent in working with a high-risk pregnancy. When patients with EDS sustain deep cuts or surgical wounds, they generally require a longer time to allow for wound healing. This means that sutures are typically left in for longer periods and providers should monitor for signs of infection very closely. Physicians may try pain medications in patients with EDS as well. Nonsteroidal anti-inflammatory medications can be beneficial for up to moderate pain levels but these often worsen digestive issues in the EDS population. Opioids are not recommended unless the patient has acute pain from an injury. Tramadol has been an effective choice for pain management in children. Steroids can be used temporarily but increase the risk of further connective tissue degradation as a side effect. Medication for mood disorders including antidepressants and serotonin reuptake inhibitors should also be used sparingly as patients may experience dysregulation of their autonomic nervous system (dysautonomia).

FLEX CEUS
FlexTherapyCEUs.com

Prolotherapy [22]

Prolotherapy describes injecting an irritant to a joint that is injured or causing symptoms of pain or hypermobility. The injection typically includes lidocaine for pain control, dextrose, and growth factors to stimulate healing and strengthening of tendons. Prolotherapy helps reduce pain and promotes joint healing throughout the body. This is true for joints that have dislocated and are recovering and for joints that are painful from overuse or due to weakening collagen and disease progression. The three types of prolotherapy are growth factor injection, growth factor stimulation, and inflammatory prolotherapy. Growth factor injection prolotherapy involves injecting substances that will support the growth of fibroblast cells that comprise connective tissue. Growth factor stimulation prolotherapy involves the injection of connective tissue growth factor and basic fibroblast growth factor which assist with pain control and healing by commanding

fibroblasts to the site of injection. Inflammatory prolotherapy includes injecting high amounts of dextrose and pain control compounds such as lidocaine to allow increased local inflammation. This inflammation will elicit a bodily immune healing response, allowing resources such as fibroblasts and immune cells to travel to the injection site.

Bracing[23,24]

Bracing is recommended by the medical community when joints are very painful and at risk of recurrent dislocation. There is controversy in the opinion of when to implement bracing. Some opinions support only bracing after an injury and during recovery and others believe that bracing is preventative and a good way to manage pain. The risk of bracing long-term is progressive muscle weakening due to the braces completing the support that muscles would normally be responsible for. There are a few companies that specialize in supportive braces for nearly every joint, including the company Bauerfeind. They sell wrist, knee, ankle, shoulder, and spinal supportive braces. Kyphoscoliotic EDS may require bracing to compensate for the scoliotic curve in the spine and to prevent progression of this. Patients may require surgical correction of the spine, followed by the need to wear a supportive structural brace.

Support Groups [25,26]

There are a few support groups and great resources involving patients with Ehlers Danlos Syndrome. The largest resource is The Ehlers-Danlos Society, where patients and therapists will find information on everything about the disorder. There is also the option for patients, families, spouses, and children to join support group meetings through the Ehlers-Danlos Society. Another resource for patients with EDS is called EDS Awareness, which is a site that has information on living with EDS and a resource of local support groups.

Section 2 Summary

Ehlers Danlos Syndrome has a specific diagnostic criterion based on the type, which almost always involves a physical examination and molecular genetic testing. Patients with EDS should have a team of practitioners working with them including primary care, specialists such as cardiologists and orthopedists to address specific concerns and physical and occupational therapists to support quality of life. There are many support

FLEX CEUs
FlexTherapistCEUs.com

groups for patients with EDS, and clinicians should always educate patients on how to utilize these resources to support psychosocial wellbeing.

Section 2 Key Words

Carotid-cavernous sinus fistula – a network of vessels that develop atypically between the carotid artery and the cavernous sinus in response to a tear in the artery

Prolotherapy – an injection therapy with specific content to reduce inflammation and promote healing in an injured or painful joint

Section 3

Physical therapy assessment and treatment will vary per type of EDS. Physical therapy will typically impact patients with hypermobile and classical subtypes in pain management, improving quality of life, and strengthening to prevent musculoskeletal complications.

FLEX CEUs
PhysicalTherapistCEUs.com

Physical Therapy Assessment [1,27–31]

Physical Therapists must understand the clinical presentation of Ehlers Danlos Syndrome to identify it and refer appropriately for genetic confirmation of diagnosis. Physical therapists should assess patients based on what symptoms they come in for and perform an entire upper or lower quarter examination. Physical Therapists should be competent and efficient in performing the Beighton scale items to confirm joint hypermobility. Assessment should include a skin check to determine the laxity of skin and monitor for excess bruising. It should also include postural assessment. People with EDS will exhibit certain postures based on the type of EDS. Patients with kyphoscoliotic EDS will have scoliosis with kyphosis in their thoracic spine, which may worsen with age. Patients with spondylodysplastic EDS will have a shorter stature and patients with arthrochalasia EDS will exhibit hip dislocations at birth. Patients with hypermobility and classical types will likely present with postural abnormalities. Most of the posture abnormalities are due to poor proprioception at joints and increased laxity and extension at certain joints. Patients with hypermobility could display pes planus, or flat foot, genu recurvatum (excess knee hyperextension), excess lumbar lordosis, and excess

shoulder internal rotation. These postures predispose patients to injury of deeper structures, muscle strains, ligament strains, and joint dislocations. Physical therapists should monitor for these impairments and educate patients on their increased risk of injury and offer strengthening and joint stability programs.

Physical Therapists should be able to distinguish between EDS and other processes such as Charcot Marie Tooth (CMT), Osteogenesis Imperfecta (OI), and Marfan Syndrome. CMT is a disease to the peripheral nervous system and causes motor and sensory neuropathy. This can lead to progressive weakness in the muscles and is an inherited disorder. Depending on the severity, patients need bracing due to weakness and paralysis of the legs and need to learn compensatory strategies due to poor proprioception, balance, and wound healing. CMT differs from the common types of Ehlers Danlos Syndrome in many ways. With EDS, joint laxity is most affected and with CMT the predominant distinguisher is muscle weakness in a peripheral nerve pattern. Osteogenesis imperfecta is an inherited disorder where bones are incredibly brittle, and patients are at risk for recurrent fracture. Common characteristics of OI are osteoporosis, blue sclerae, hearing loss, scoliosis, contractures at joints, short stature, and problems with the respiratory system. The milder versions of OI can mimic some types of EDS based on blue sclerae, scoliosis, and short stature. Marfan syndrome is an inherited disorder resulting from a mutation in the gene that creates the protein fibrillin-1. This results in problems with connective tissue in organs, joints, ligaments, vasculature, and other areas. Marfan syndrome ranges from mild symptoms and features such as long limbs, thin frame, scoliosis, pes planus, and pliable skin to serious conditions of vessel enlargement of the aorta, lung collapse, and poor vision. Physical Therapists need to recognize common features of these conditions for differential diagnosis and to refer to primary care when they detect these disorders for comprehensive management of patients.

Physical Therapy Treatment [1,21,32–35]

Physical therapy plays a large role in optimizing the quality of life for patients with EDS. Therapists need to perform a comprehensive assessment to best understand the pathology a patient is seeking therapy for and how EDS will impact healing and return to the highest functional level. Physical therapists and physical therapist assistants at the direction of physical therapists should focus on decreasing symptoms and preventing further disability with education on activity modification. Areas of focus include

implementing splints and braces, taping, manual therapy, orthotics and footwear, cardiovascular conditioning, strengthening, and durable medical equipment.

Splints, Bracing, Taping

As a general rule, splints and bracing should only be encouraged for patients with EDS to recover from surgery to a joint or when pain and joint hypermobility are severe. This is due to the risk of developing a dependency on the support and losing muscle supporting strength. Compensation in the form of splints, bracing and taping can improve joint position and prevent dislocation for patients with EDS. Some special considerations for bracing for patients with EDS include having adequate structural support with comfortable padding so skin is not torn or damaged. Physical Therapists should always perform a thorough examination and subjective history to gain insight into whether a patient would benefit from splints and braces. Patients generally do not benefit from the shoulder, hip, or neck braces that are bulky and interfere with daily movement, unless recovering from surgery. Patients may benefit from one neck brace called a Vista Aspen brace with chronic neck pain to alleviate pressure on the lax joints in the cervical spine. Patients generally benefit from splints in the fingers to prevent injury to the interphalangeal joints. These splints include swan neck and boutonniere splints to prevent hyperextension of the proximal interphalangeal joint. There are also thumb splints that stabilize the metacarpophalangeal joint to prevent dislocation.

https://www.breg.com/products/spine-bracing/cervical-clavicle/vista-cervical-collar/

FLEX CEUs
FlexTherapistCEUs.com

Taping with the goal of joint stability and activation of muscles is a strategy that can help manage symptoms. Kinesiotape is used to stimulate sensory nerve fibers to improve activation and correct the action of muscles during daily activities. This may help improve pain and proprioception throughout the body. Kinesiotape can be used surrounding any joint, most commonly at the low back, shoulders, knees, and ankles. This picture exemplifies how a therapist would Kinesiotape around the knee to help train the knee to avoid hyperextension in gait.

Manual Therapy

Myofascial release through soft tissue mobilization can be a helpful technique in providing pain relief and encouraging correct muscle activation. Therapists should target trigger points and areas of muscle tension and avoid any positions where the patient is stretching or mobilizing hypermobile joints. Gentle joint mobilization is appropriate if the patient presents with abnormal joint positioning and the goal is to remediate this followed by strengthening of supporting muscle groups. Physical therapy would typically begin sessions with manual therapy aimed to remediate tension in overactive muscles and followed by proprioceptive and activation exercises.

Footwear

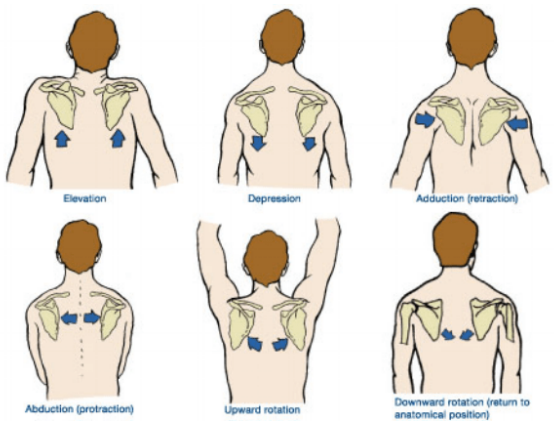
Therapists should educate patients with EDS on proper footwear. Due to common foot posture of extreme pronation, patients benefit most from supportive shoes with full foot coverage, heel support, good cushioning, and arch support. Some patients who have foot and lower extremity pain despite always wearing supportive footwear may benefit from foot orthotics. The goal of the orthotics is to support the arch of the foot in the hindfoot and medial arch. The use of orthotics is controversial as foot intrinsic muscles will weaken. However, if gait impairment is severe enough and the patient has pain ambulating, orthotics may be necessary for long-term pain management and improved gait stability and pattern.

FLEX CEUs
FlexTherapistCEUs.com

Cardiovascular Conditioning

Just like the general public, people with EDS should perform aerobic exercise for good cardiovascular health. Aquatic exercise is an excellent strategy for exercise as this will not put pressure on unstable joints. Due to high rates of chronic pain and fatigue, people with EDS are often not exercising enough for the benefit of their cardiovascular health. The role of a therapist is to educate on the benefits of aerobic exercise and tailor a program that the patient can complete with little pain. This may involve low impact exercise such as cross-training, bicycling, or swimming at least 30 minutes per day, and three to five sessions per week. Therapists should educate on pain management and pacing strategies to avoid exacerbating chronic pain. Completing regular aerobic and endurance exercise can lessen a patients' hyperalgesia response to movement by improving progressive tolerance to movement. This has the benefit of crossing over to general mobility and daily life.

Strengthening



https://westcoastsci.com/blog/importance-of-scapular-shoulder-stability/

Therapists must educate and implement strengthening programs to prevent the sequelae of joint instability and dislocation. Therapists should be involved in the recovery process in an acute injury where strengthening would begin with gentle activation exercises and progress to resistive strengthening. It is also recommended that people with hypermobility associated with EDS be participating in an exercise program designed to relieve pain and strengthen supportive muscles around hypermobile joints. Lower extremity strengthening should be based on a comprehensive lower quarter assessment. It generally will include hip rotator and abduction strength to target muscles such as the gluteus medius and maximus and the internal and external rotators. The knee flexors and extensors should be targeted as well as a common gait disturbance is knee hyperextension. The ankle invertors and foot intrinsic muscles will benefit from strengthening as patients often present with ankle eversion and foot overpronation. Strengthening should be attempted before suggesting foot orthoses so a patient can use all available muscle strength and potential and avoid relying on external devices as long as possible. Core and deep neck flexor strengthening are imperative in an exercise program to prevent and lessen the degree of spinal pain associated with joint laxity. These should begin with activation exercises such as supine pelvic tilts and chin tucks to glute bridges cuing for core activation and supine chin tuck holds with cervical flexion. Core activation should be cued for in each lower extremity and whole-body strengthening exercise that a therapist progresses a patient to. This will lessen the risk for spinal pain not only within the exercise program but in daily life as well. Therapists should also work on strengthening the scapular and shoulder stabilizing muscles. Strengthening should be based on weaknesses or prior injuries detected in an upper quarter examination. Weakness and poor activation are common in the rotator cuff and the scapular stabilizers such as the serratus anterior, rhomboids, and trapezius. Movements would target scapular retraction, rotation, protraction, and depression coupled with appropriate glenohumeral movement. Strengthening should begin with careful monitoring of muscle compensations in activation exercises with no resistance throughout the progression to resistive combined movements. Clinicians working with patients with EDS should carefully monitor for skin breakdown, bruising, and pain before

FLEX CELLS
Flex therapist cells.com

and after completing home exercise programs. This is especially important for patients with EDS as pain and injury rates to the joints are much more common than in the general public.

DME

Patients with restricted mobility or recovering from joint dislocations in the lower extremities may benefit from durable medical equipment like assistive devices. Patients may need crutches or a walker after surgery for a joint dislocation, where they can transition back to using no device. Some patients who are at high fall risk per standardized testing or who have unrelenting pain and joint instability may benefit from the long-term use of an assistive device. A wheeled walker will be helpful for patients who are typically older, have gait deviations such as a wide base of support and ataxia, as a long-term device to avoid falling. If gait disturbances, weakness, and pain worsen to the point of immobility, a wheelchair fitting would be appropriate. Physical therapists and wheelchair specialists should ensure proper wheelchair fitting, decide if power or a manual chair is more appropriate, and provide appropriate cushioning to avoid skin breakdown and to provide comfort. It is important for therapists to always recommend the least restrictive assistive device to optimize the muscle strength and mobility that a patient has rather than having the patient become reliant on an external device.

FLEX CEUS
FlexTherapistCEUs.com

Considerations with Children

Children going through motor development will benefit from physical therapy for strengthening, balance, and proprioception to keep up with their peers. Patients may also benefit from assistive devices and orthotics just like adults, but with more frequent assessments due to growth periods. Children with the rarer types of EDS, such as arthrochalasia and kyphoscoliotic types will benefit from more serious braces and medical intervention such as spinal alignment surgery and hip-knee-ankle-foot orthoses or thoracic lumbar sacral orthoses during recovery. Children with all types of EDS should be followed closely by the medical team at large and physical therapy to intervene in achieving developmental milestones and supporting muscle and joint health as growth occurs.

Section 3 Summary

Physical therapy is an integral field in managing patients with EDS. Therapists should be aware of the challenges that patients with EDS face and be prepared to intervene in pain management, strengthening, proprioception, and prescribe appropriate assistive devices to optimize quality of life.

Section 3 Key Words

Charcot Marie Tooth – an inherited disorder where peripheral nerves are damaged resulting in poor sensory and motor innervation throughout the body

Osteogenesis Imperfecta – an inherited disorder where bones are extremely brittle

Marfan Syndrome – an inherited disorder that alters the function of connective tissue resulting in systemic and musculoskeletal problems

Hyperalgesia – a response to pain that is greater than the expected pain response

FLEX CEUS
FlexTherapistCEUs.com

Section 4

Case Study

Sarah is a 17-year-old female who presents to physical therapy with the referral of her primary care physician. She had just sustained a left shoulder dislocation during a basketball game. She had it relocated to the emergency department and her primary care physician referred her to physical therapy after the procedure for strengthening. Sarah's mother presents to the physical therapy evaluation stating this was common for her as well as a child. Sarah was recently diagnosed with Ehlers Danlos Syndrome but does not know if it will affect her life at all.

Reflection Questions

1. What other information may a therapist inquire about before assessing Sarah?

2. What type of EDS does Sarah probably have and how would it be confirmed?
3. What assessment items should a therapist perform?
4. What considerations should therapists follow with intervention knowing that Sarah has Ehlers Danlos Syndrome?
5. What should a clinician educate this patient about before her first visit concludes?

Responses

1. A therapist should inquire if a joint dislocation has occurred before and the circumstances around it. It is also important to know what activities Sarah does daily, if there is a family history of EDS or joint hypermobility, and pain level at the shoulder.
2. Sarah appears to have the hypermobile type of EDS which would be confirmed with an assessment of the Beighton scale and genetic testing for mutation of the COL5A1 or COL5A2 genes.
3. A full upper quarter examination and assessment of the Beighton scale items should be completed at the evaluation. A therapist should also monitor for excess bruising and skin breakdown as these are common with EDS. To determine normal shoulder function for Sarah, joint mobility and strength testing should be performed on her right shoulder to serve as a control for the left. The left shoulder should be assessed only passively due to the recent dislocation.
4. Therapists should perform a gentle passive range of motion to active and resistive for return of function of the left shoulder per protocol. When performing any soft tissue mobilization or manual therapy, clinicians should be careful to monitor bruising and use lotion to avoid skin breakdown. Therapists should monitor for chronic pain and implement education, general strengthening, and activation of weak muscles to prevent another shoulder dislocation or injury in the lower extremity or spine.
5. It is crucial to educate patients with EDS on the avoidance of contact sports in favor of an aerobic and gentle strengthening exercise program for general health and the prevention of joint injury. Sarah should not continue to play basketball

FLEX CEUS
PhysicalTherapistCEUs.com

even after her dislocation heals because she is at risk for further joint injury and degradation.

Conclusion

Ehlers Danlos Syndrome is a relatively rare group of disorders that impair the function of connective tissue in the body. This results in a variety of systemic and musculoskeletal symptoms requiring a multidisciplinary approach in the diagnosis and management of the condition. Physical Therapists and Physical Therapist Assistants should be well versed in recognizing Ehlers Danlos Syndrome across the lifespan and be trained on intervention strategies for optimizing the quality of life in their patients.

FLEX CEUs
FlexTherapistCEUs.com

References

1. Ehlers-Danlos Syndrome. Physiopedia. Accessed February 14, 2022. https://www.physio-pedia.com/Ehlers-Danlos_Syndrome
2. Miklovic T, Sieg VC. Ehlers Danlos Syndrome. In: StatPearls. StatPearls Publishing; 2022. Accessed February 22, 2022. http://www.ncbi.nlm.nih.gov/books/NBK549814/
3. Collagen. Physiopedia. Accessed February 22, 2022. https://www.physio-pedia.com/Collagen
4. Ehlers-Danlos syndromes. nhs.uk. Published October 18, 2017. Accessed February 21, 2022. https://www.nhs.uk/conditions/ehlers-danlos-syndromes/
5. Engelbert RHH, Juul-Kristensen B, Pacey V, et al. The evidence-based rationale for physical therapy treatment of children, adolescents, and adults diagnosed with joint hypermobility syndrome/hypermobile Ehlers Danlos syndrome. Am J Med Genet C Semin Med Genet. 2017;175(1):158-167. doi:10.1002/ajmg.c.31545
6. The Types of EDS. The Ehlers Danlos Society. Accessed February 15, 2022. https://www.ehlers-danlos.com/eds-types/
7. Zaunbrecher N. Types of Ehlers-Danlos Syndrome - Ehlers-Danlos News. Accessed February 15, 2022. https://ehlersdanlosnews.com/types-of-ehlers-danlos-syndrome/
8. Tinkle B, Castori M, Berglund B, et al. Hypermobile Ehlers–Danlos syndrome (a.k.a. Ehlers–Danlos syndrome Type III and Ehlers–Danlos syndrome hypermobility type): Clinical description and natural history. Am J Med Genet C Semin Med Genet. 2017;175(1):48-69. doi:10.1002/ajmg.c.31538
9. Brady AF, Demirdas S, Fournel-Gigleux S, et al. The Ehlers-Danlos syndromes, rare types. Am J Med Genet C Semin Med Genet. 2017;175(1):70-115. doi:10.1002/ajmg.c.31550
10. PhD EM. Dermatosparaxis EDS – Ehlers-Danlos News. Accessed February 21, 2022. https://ehlersdanlosnews.com/dermatosparaxis-eds/

FLEX CELLS
FlexTherapyCELLS.com

11. van Dijk FS, Mancini GMS, Maugeri A, Cobben JM. Ehlers Danlos syndrome, kyphoscoliotic type due to Lysyl Hydroxylase 1 deficiency in two children without congenital or early onset kyphoscoliosis. Eur J Med Genet. 2017;60(10):536-540. doi:10.1016/j.ejmg.2017.07.011

12. Beighton score. Physiopedia. Accessed February 24, 2022. https://www.physiopedia.com/Beighton_score

13. Bockhorn LN, Vera AM, Dong D, Delgado DA, Varner KE, Harris JD. Interrater and Intrarater Reliability of the Beighton Score: A Systematic Review. Orthop J Sports Med. 2021;9(1):2325967120968099. doi:10.1177/2325967120968099

14. Bevilacqua DE, S M, J F. Measuring Joint Hypermobility Using the Hospital Del Mar Criteria - A Reliability Analysis Using Secondary Data Analysis. Arch Rheumatol Arthritis Res. 2019;1(1):1-6.

15. Adham S, Trystram D, Albuisson J, et al. Pathophysiology of carotid-cavernous fistulas in vascular Ehlers-Danlos syndrome: a retrospective cohort and comprehensive review. Orphanet J Rare Dis. 2018;13:100. doi:10.1186/s13023-018-0842-2

16. Gu G, Yang H, Cui L, et al. Vascular Ehlers-Danlos Syndrome With a Novel Missense COL3A1 Mutation Present With Pulmonary Complications and Iliac Arterial Dissection. Vasc Endovascular Surg. 2018;52(2):138-142. doi:10.1177/1538574417745432

17. PhD EM. How EDS Affects Mental Health – Ehlers-Danlos News. Accessed February 26, 2022. https://ehlersdanlosnews.com/2020/06/10/mental-health-anxiety-depression-chronic-pain-fatigue/

18. Gilliam E, Hoffman JD, Yeh G. Urogenital and pelvic complications in the Ehlers-Danlos syndromes and associated hypermobility spectrum disorders: A scoping review. Clin Genet. 2020;97(1):168-178. doi:10.1111/cge.13624

19. Hypermobile Ehlers-Danlos Syndrome. Published April 20, 2017. https://rarediseases.info.nih.gov/diseases/2081/hypermobile-ehlers-danlos-syndrome

20. PhD EM. Will EDS Affect my Life Expectancy? – Ehlers-Danlos News. Accessed February 24, 2022. https://ehlersdanlosnews.com/2020/02/13/will-eds-affect-my-life-expectancy/

FLEX CEUS
FlexCEUs.com

21. Zhou Z, Rewari A, Shanthanna H. Management of chronic pain in Ehlers–Danlos syndrome. Medicine (Baltimore). 2018;97(45):e13115. doi:10.1097/MD.0000000000013115

22. DSouza AD. Prolotherapy – Ehlers-Danlos News. Accessed February 24, 2022. https://ehlersdanlosnews.com/prolotherapy/

23. EDS Resource Page | Guides | Health. Bauerfeind. Accessed February 28, 2022. https://www.bauerfeind.com/b2c/Health/Guides/EDS-Resource-Page/c/eds-resource-page

24. Neidler S. Kyphoscoliotic EDS – Ehlers-Danlos News. Accessed February 28, 2022. https://ehlersdanlosnews.com/kyphoscoliotic-eds/

25. Ehlers Danlos Syndrome Support Groups. EDSAwareness.com. Accessed February 28, 2022. https://www.chronicpainpartners.com/supportgroups/local-support-groups/

26. Virtual Support Groups. The Ehlers Danlos Society. Accessed February 28, 2022. https://www.ehlers-danlos.com/virtual-support/

27. MORE THAN HYPERMOBILE: EHLERS-DANLOS AND ITS RARER FORMS. The Ehlers Danlos Society. Published May 16, 2018. Accessed February 27, 2022. https://www.ehlers-danlos.com/more-than-hypermobile/

28. Dupuy EG, Leconte P, Vlamynck E, et al. Ehlers-Danlos Syndrome, Hypermobility Type: Impact of Somatosensory Orthoses on Postural Control (A Pilot Study). Front Hum Neurosci. 2017;11. Accessed February 27, 2022. https://www.frontiersin.org/article/10.3389/fnhum.2017.00283

29. Charcot-Marie-Tooth Disease Fact Sheet | National Institute of Neurological Disorders and Stroke. Accessed February 27, 2022. https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Charcot-Marie-Tooth-Disease-Fact-Sheet

30. Osteogenesis imperfecta: MedlinePlus Genetics. Accessed February 27, 2022. https://medlineplus.gov/genetics/condition/osteogenesis-imperfecta/

31. Marfan Syndrome. Marfan Foundation. Accessed February 27, 2022. https://marfan.org/conditions/marfan-syndrome/

FLEX CEUS
FlexTherapistCEUs.com

32. Spanos, Alan. Physical Therapy, Exercise and Braces for People with EDS or HSD. Published online March 2019.

33. Physical therapy for hypermobility – The Ehlers-Danlos Support UK. Accessed February 27, 2022. https://www.ehlers-danlos.org/information/physical-therapy-for-hypermobility/

34. Ehlers-Danlos Syndrome - EDS | Connective tissue disorder causing joint hypermobility. Silver Ring Splint. Accessed February 28, 2022. https://www.silverringsplint.com/problems-addressed/eds/

35. Corrado B, Ciardi G. Hypermobile Ehlers-Danlos syndrome and rehabilitation: taking stock of evidence based medicine: a systematic review of the literature. J Phys Ther Sci. 2018;30(6):843-847. doi:10.1589/jpts.30.847

FLEX CEUs
FlexTherapistCEUs.com

The material contained herein was created by EdCompass, LLC (”EdCompass”) for the purpose of preparing users for course examinations on websites owned by EdCompass, and is intended for use only by users for those exams. The material is owned or licensed by EdCompass and is protected under the copyright laws of the United States and under applicable international treaties and conventions. Copyright 2022 EdCompass. All rights reserved. Any reproduction, retransmission, or republication of all or part of this material is expressly prohibited, unless specifically authorized by EdCompass in writing.