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Case Study

A Pediatric Case Study of Scoliosis with Torticollis

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Abstract

Approximately 2-5% of children in the U.S. will develop scoliosis [1]. Over time, scoliosis can cause pain and discomfort and if left untreated, has the potential to impact other organs of the body, such as the lungs or heart [1]. With the addition of a torticollis diagnosis, or "twisted neck", this can also cause the infant to have issues such as pain and limited range of motion to the head and neck [2]. There are studies to suggest that an infant diagnosed with torticollis could later develop scoliosis [3]. It is important to gain a quick diagnosis for both scoliosis and torticollis to ensure a customized treatment plan that will be beneficial for the child.

Educational Objectives

Upon completion of this article, the healthcare professional should be able to:

- Understand the importance of quick diagnosis of torticollis and scoliosis in children
- Bring awareness on treatment options to improve torticollis and scoliosis
- Learn the importance of follow-up spine imaging after a scoliosis diagnosis
- Gain a better understanding of the spinal anatomy
- Discover the proper care of the Mehta cast and TLSO brace

Introduction

Torticollis can be a congenital or acquired deformity characterized by an abnormal rotation of the cervical spine and tilting of the head [4]. Torticollis is fairly common in infants, but it will be important that the infant seeks medical evaluation. Upon a full clinical history from the physician, a physical examination will also be necessary. A physician typically will notice a tight or contracted sternocleidomastoid muscle that feels like a hard, palpable mass in the midsection of the cervical spine area [5]. This abnormality will most likely warrant some type of further testing, such as diagnostic imaging. Once further testing is complete, it will give physicians a better understanding of the root cause of this torticollis diagnosis. Four primary reasons for developing torticollis include: the position of the baby in the womb, abnormal development of the sternocleidomastoid muscle, trauma/damage during birth, and/or, underlying conditions such as bony abnormalities, dwarfism, or Klippel-Feil syndrome [1].

Scoliosis is a type of spinal deformity with a lateral curvature of the spine greater than 10 degrees accompanied by rotation of the vertebrae, which brings the ribs anteriorly in the direction of the rotation [6,7,8]. It is also the most common spinal disorder in children and adolescents [9]. However, the length of the spine increases by 50% in the first five years of life, therefore, neglecting early-onset scoliosis can lead to additional complications such as poor thoracic development and early mortality [10]. Furthermore, a proper treatment plan is imperative for correcting a spinal deformity without compromising normal spinal growth [10]. Three primary reasons for developing scoliosis include: age: signs and symptoms typically begin in adolescence, gender: females have a higher risk of the curve worsening and requiring treatment due to hormonal factors and skeletal growth patterns, and lastly is family history: scoliosis has the potential to run in the family [11,12,13]. Additionally, research has not found a cause for scoliosis in infants, although this condition does seem to run in the family [2].

Anatomy of the Spine

The vertebral, or spinal column forms the central axis of the skeleton [14,15]. Its primary function is to provide flexible support for the head and trunk of the body, as well as enclosing and protecting the spinal cord [14, 16]. The vertebral column consists of 33 small, irregularly shaped bones, called the vertebrae [14]. These irregular bones are divided into five categories: cervical, thoracic, lumbar, sacrum, and coccyx. The cervical spine vertebrae are the smallest non-fused vertebrae in the body and are identified at C1 to C7, with C1 as the atlas and C2 as the axis [16]. The thoracic spine vertebrae are much larger and have similar characteristics to the lumbar spine. They are identified as T1-T12. The lumbar spine vertebrae are the largest and the strongest of the vertebral bodies due to increase in weight distribution [16]. They are identified as L1-L5. The sacrum is formed by the fusion of the five sacral vertebral segments [14]. Lastly, the coccyx is composed of three to five, normally four fused vertebral segments [14].

Typically, vertebrae are composed of two parts: the body and the vertebral arch [14]. The body is composed of cancellous bony tissue covered by compact tissue [14]. "The vertebral arch consists of two pedicles, two lamina that support four articular processes, two transverse processes, and one spinous process" [14]. Cervical spine vertebrae also have transverse foramen to allow the passage of the vertebral veins and arteries. A unique feature of the thoracic spine vertebrae is the facet joints for rib articulation. The facet joints protrude on each side of the vertebral body to articulate with the head of the rib and form a costovertebral joint [16]. As for the lumbar spine, these vertebral bodies increase in size from the first to the fifth vertebrae [14]. Finally, the sacrum and coccyx are unique because they are fused vertebral segments. Thus, many would state there are 24 vertebrae: with seven cervical vertebrae, twelve thoracic vertebrae, five lumbar vertebrae, plus the sacrum and coccyx.

Classifications of Torticollis and Scoliosis

There are two main classifications for torticollis: congenital and acquired. Congenital torticollis, normally seen in neonatal patients and infants, accounts for approximately 1 per 250 newborn births per year and typically results from craniocervical vertebral anomalies or muscular issues, usually involving the sternocleidomastoid muscle [4,17,18]. Also, with congenital torticollis, typically, the infant's head will tilt to one side. Additionally, the child will have a limited range of motion in the head and neck area, a lump that can be found near the sternocleidomastoid muscle due to spinal rotation, and additional muscular pathologies can arise, such as hip dysplasia [2,19]. There are three sub-categories of congenital torticollis: postural, muscular, and sternocleidomastoid mass. Postural congenital torticollis is seen in 20% of congenital torticollis cases and is a result of the infant having a postural preference without muscle tightness or a limited range of motion [18,20]. Muscular congenital torticollis is seen in 30% of congenital torticollis cases and has a tightness of the sternocleidomastoid muscle with limited range of motion [18,20]. Lastly, sternocleidomastoid mass accounts for 50% of congenital torticollis cases and results in a thickening of the sternocleidomastoid muscle and restricted range of motion [18,20]. Conversely, acquired torticollis, normally seen in children and adolescents, is usually secondary to trauma, infection, or other pathologies, such as a tumor [4]. With acquired torticollis, the infant's head will also tilt to one side. Furthermore, the patient will have limited range of motion in the head and neck area, may acquire a condition called benign paroxysmal torticollis, (a recurrent episode of head tilting accompanied with vomiting and nausea), and if there is trauma associated with torticollis, the patient should be evaluated for injury to the cervical spine, specifically C1 and/or C2 [2,19].

There are two primary classifications of scoliosis: idiopathic and non-idiopathic [8,16,21]. Idiopathic, or unknown cause, is the most common form of scoliosis and is seen in approximately 80% of cases [17]. It comprises three different types [14,16].

1. **Adolescent:** Affects mostly girls between the ages of 11-17
   a. This subtype accounts for close to 90% of idiopathic scoliosis cases in children [9,16]
2. **Juvenile:** Affects children between the ages of 4-10
   a. This subtype accounts for approximately 10% of idiopathic scoliosis cases [9,16].
3. **Infantile:** Affects children between birth and three years old
   a. This subtype accounts for approximately 1% of idiopathic scoliosis cases [9,16].

Non-idiopathic scoliosis, or there is an underlying cause is the second classification. It comprises three types [14,16].

1. **Neuromuscular**
   a. This type of non-idiopathic scoliosis affects the nervous and muscular systems [14]. Typically, it is a result of insufficiently functioning active spinal stabilizers (such as muscles and tendons) and can be accompanied by pathologies such as cerebral palsy or spina bifida [16].
2. **Congenital:**
   a. This type occurs in-utero between 3-6 weeks of gestation and can cause partial, missing, or fused vertebrae, and can be accompanied by pathologies such as tethered cord or Chiari malformation [14,17].
3. **Mesenchymal:**
   a. This type can develop because of insufficiently functioning passive spinal stabilizers (such as disks or joints) and can be accompanied by pathologies such as Marfan syndrome or osteogenesis imperfecta [16].

Some common signs that are present with scoliosis include, leaning to one side (dextroscoliosis is where the spine curves to the right and levoscoliosis is where the spine curves to the left), asymmetry of the ribs or surrounding muscles, uneven shoulders, uneven waist, one hip higher than the other, bump on the chest or on the muscle adjacent to the spine due to rotation of the spine, one side of the rib cage jutting forward or a prominence on one side of the back when bending forward, head not properly centered over the trunk of the body, clothes not fitting correctly, such as hems hanging unevenly, and/or difficulty breathing due to the rib cage pressing against the lungs [11,1,13].

Role of Diagnostic Imaging Aiding in Diagnosis

Diagnostic imaging can be a vital tool to aide with a torticollis diagnosis. Typically, if physical therapy has not been an effective treatment tool, an ultrasound will be the first imaging modality choice for congenital muscular torticollis, as there is no radiation source [4]. Ultrasound will provide detailed images of the musculature of the neck area to visualize any abnormalities. With acquired torticollis, conventional radiography or x-ray should be the imaging modality of choice [4] to evaluate for bony abnormalities. Computed tomography (CT) and magnetic resonance imaging (MRI) may also be utilized for further evaluation [4,18] of bony structures, muscles, ligaments, and tendons. The use of multiple modalities is a common radiologic work-up for a torticollis diagnosis [4]. In this study, we will be looking at a child with congenital muscular torticollis.

There are several imaging modalities used to aid in a scoliosis diagnosis. Radiography, CT, and MRI can all play a vital role in scoliosis evaluation [17]. Radiography or x-ray is typically the first modality for scoliosis assessment. Through x-rays, the physician will be able to measure the degree of abnormal curvature. The Cobb angle is the most widely used measurement to assess the degree of abnormal curvature on an AP (anteroposterior) view x-ray of the spine. An AP x-ray means the x-ray beam passes from the front of the patient to their back. The Cobb angle method assesses the most affected vertebrae (See Figure 1). The Cobb angle is formed by the intersection of two lines, one parallel to the upper (superior) end vertebra (UEV) and the other to the lower (inferior) end vertebra (LEV) which have the most displacement followed by the least displacement [16,17,22]. The two lines will be drawn on the radiograph either manually or digitally (through a software program) to form the angle [17]. The first line is drawn along the superior portion of the vertebrae to extend outside the body laterally, and the second line is drawn along the bottom portion of the vertebrae to extend outside the body laterally [16]. Then, these two lines will intersect and form the Cobb angle [16]. A 10-20-degree lateral curvature denotes a mild case of scoliosis, while a 20-40-degree lateral curvature denotes a moderate case of scoliosis, and lastly a lateral curvature over 40 degrees denotes a severe case of scoliosis [23]. The whole spine is imaged to determine the UEV and LEV scoliosis segments [22]. Next, the PACS (picture archiving communication systems) system is utilized to calculate the degree of scoliosis [22]. A determination will be made at this point if further testing is needed. For central nervous system concerns, MRI would be the imaging modality of choice for pathologies such as disk disease, tumor, and herniations, whereas CT would be best for fractures, hemorrhages, and infarctions [8]. In this study, we will be looking at a child with a moderate case of idiopathic scoliosis.

Treatment for Torticollis and Scoliosis

The most common type of treatment for congenital torticollis is physical therapy. Healthcare facilities will provide an exercise plan that involves the caregiver and patient (Mayo). These exercise plans can include manual stretches such as side bending the head from left to right, rotating the head, and flexion and extension neck stretches [20]. If physical therapy is unsuccessful, other treatment options could include a tubular orthosis, or a collar that is used to improve the infant's head position and provide support [18]. Another potential treatment option is surgery to lengthen or resect the sternocleidomastoid muscle [18]. If left untreated, the prolonged twisting of the neck can lead to changes in the skeletal structure, such as scoliosis [17].

There are typically three treatment options to correct scoliosis: casting, bracing, and surgery [8]. Invasive treatments such as surgery are not recommended for infants, but rather corrective treatments such as casting and bracing are suggested [24]. The first type of non-invasive treatment is the Mehta cast. Developed by Dr. Min H. Mehta, the Mehta derotational casting has been a proven treatment option for patients with idiopathic scoliosis with an abnormal curve of less than 60 degrees [25]. Those with a curve greater than 60 degrees may find benefit in the Mehta casting, but surgical intervention may be needed as well. In young children, spinal fusion restricts chest growth and can lead to severe pulmonary complications if left untreated [25]. Unfortunately, in some cases, surgery is unavoidable due to the severity of scoliosis. Although surgery with growing spinal rods has been an acceptable treatment option, it does come with possible complications such as infections or device malfunctions [25]. Through the use of the Mehta casting, the goal is to cure moderate cases without the patient having to undergo surgery. "Casting is most effective in children under age 4 as they proportionally experience the most rapid growth" [25]. Typically, physicians will change the cast every 2-3 months because the cast will get tight as the patient grows [26]. Most studies found that a patient will receive on average, five casts, but depending on how the patient responds, it could be more or less [26].

The application of the cast is done in surgery while the patient is sedated [27]. The procedure usually takes about one hour. During the procedure, layers of soft fabric are wrapped around the body under the cast to help prevent skin irritation and pressure [27]. The cast is made of either a plaster or fiberglass. In this case study, the infant's cast was made of plaster. It is normal for the cast to feel tight at first until it completely dries, which usually takes about two hours [27]. The cast typically starts just right under the axillary region and extends to the hips (See Figure 1). There is also a hole left open in the abdominal area to allow space for the belly to expand [28].

Figure 1. Image of Child in Mehta Cast

Another type of treatment is bracing. There are three different types of bracing: Thoracolumbosacral Orthosis (TLSO) brace (worn full-time), Night-time Hypercorrective TLSO, and Cervico-Thoraco-Lumbo-Orthosis (CTLSO) [29]. Generally, the TLSO brace is worn about 18-20 hours a day (Asher) (See Figure 2). This type of brace extends from the axillary region to just below the hips and is considered the gold standard for managing idiopathic scoliosis [29]. Next is the night-time hypercorrective TLSO which is just worn at night and also extends from the axillary region to just below the hips. This type of brace is only worn in a supine position when the spine is more flexible and gravity is not influencing the spine [29]. Last is the CTLSO brace which extends from the neck to the bottom of the hips and is to be worn 18-20 hours a day [29]. With this type of brace, it is best utilized for patients who have an abnormal curve starting in the cervical spine [29]. After the casting and bracing, if the spinal curvature is less than 20 degrees, the child will have x-rays every 4-6 months during their growing years to ensure the curvature is not progressing [27]. In this study, the child wore a TLSO brace.

Figure 2. Image of Child in TLSO Brace

Case Study

A two-month-old child presents to the pediatrician's office with a noticeable abnormal curvature to the neck area while trying to hold her head up. The infant's mother states that she did not really notice any issues with the infant until now, as there were no pregnancy or birthing complications. Once the infant attempted to hold her head up, family members noticed she was holding her head to the right. The child had no other issues and a calm demeanor. After a physical examination of the patient, the pediatrician made a referral for physical therapy. During the initial physical therapy treatment, it was determined the patient had hypotonia, or low tone, which is decreased muscle tone in the neck, and is a form of congenital muscular torticollis. The child underwent six weeks, twice a week, of physical therapy and improved drastically. No signs of torticollis resumed after treatment.

A few months later, family members of the now six-month-old child noticed when the she was sitting up, she was slouching to the right. The child's mother addressed her concerns with the pediatrician. The pediatrician made a referral to an osteopathic doctor. During the visit with the osteopathic doctor, they recommended chiropractic treatment. The patient underwent four treatments over the next two months and showed no improvement. The patient is now approaching one-year-old, and the mother returns to the pediatrician's office and requests x-rays to be done to rule out scoliosis. The x-rays confirmed that the patient does have idiopathic infantile thoracolumbar scoliosis. The pediatrician then made a referral to a children's hospital for further evaluation. Upon arrival to the children's hospital, additional x-rays were taken and revealed that the patient has dextroscoliosis (where the spine curves to the right) and abnormal lateral curvature of 22 degrees. Per hospital protocol, casting does not typically take place until there is an abnormal curvature of 25 degrees. It was then determined that the children's hospital would monitor the patient and re-evaluate in a few months. Three months later after the initial children's hospital visit, the patient returned for further evaluation. From there, additional x-rays were taken and revealed the dextroscoliosis had worsened. An AP (anteroposterior) x-ray was obtained. The abnormal curvature was now 34 degrees (See Figure 3). The physician determined that the best course of action would be a series of Mehta casts and a TLSO brace for stabilization. The casts are typically left on the patient for 2-3 months with a week break in between casts. The time in between each cast is used for skin healing. The skin can become very irritated from the cast and brace. Ointments such as Vaseline or Aquaphor are good options for skin repair.

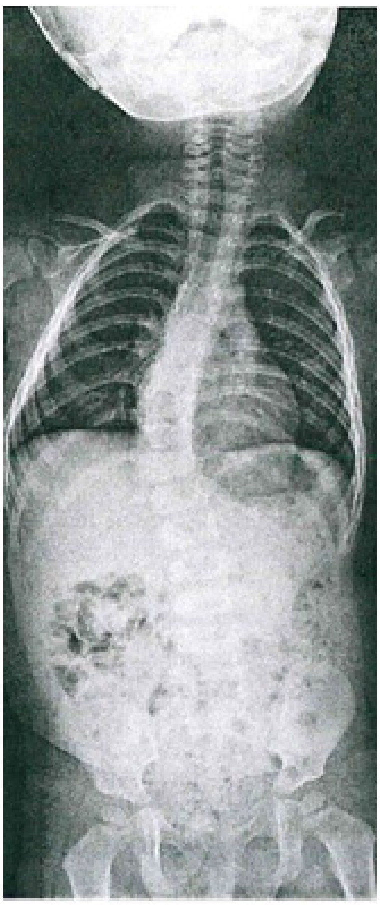

Figure 3. AP X-Ray Prior to First Mehta Cast with Cobb angle

On March 10, 2020, the now almost two-year old patient had her first Mehta cast procedure. Prior to the procedure her scoliosis was measuring a 34-degree dextroscoliotic curvature. The procedure went well and the patient had no complications. Approximately three months later, the first cast was removed. The child then had a little over a week break from the cast until May 18, 2020 when the second cast was placed with a 17.2 curvature going into the procedure. Again, the child had a little over a week break before returning for a third cast. During the third cast procedure on July 14, 2020, the physician decided to mold her for a brace because of her drastic spinal improvement, now measuring approximately a 10-degree dextroscoliotic curvature. On September 14, 2020, her third and final cast was removed and she was placed into a TLSO brace. On June 14, 2021, the patient was given a new TLSO brace due to out-growing the first brace. On November 1, 2021, the now three-year child had her final TLSO brace removed. (See Table 1). Before the patient was released from treatment, she had an AP (anteroposterior) x-ray (See Figure 4). The x-ray revealed only a slight curvature of the spine. Research shows that it is typical for a patient with infantile idiopathic scoliosis to be in treatment for up to 2 years [29]. This patient was in a cast and brace for approximately 19 months.

Table 1:Surgical Dates and Removal Dates of Mehta Casts and TLSO Braces

Cast/Brace	Surgical Date	Removal Date
1st Mehta Cast	March 10, 2020	May 7, 2020
2nd Mehta Cast	May 18, 2020	July 9, 2020
3rd Mehta Cast	July 14, 2020	September 14, 2020
1st TLSO Brace	September 14, 2020	June 14, 2021
2nd TLSO Brace	June 14, 2021	November 1, 2021

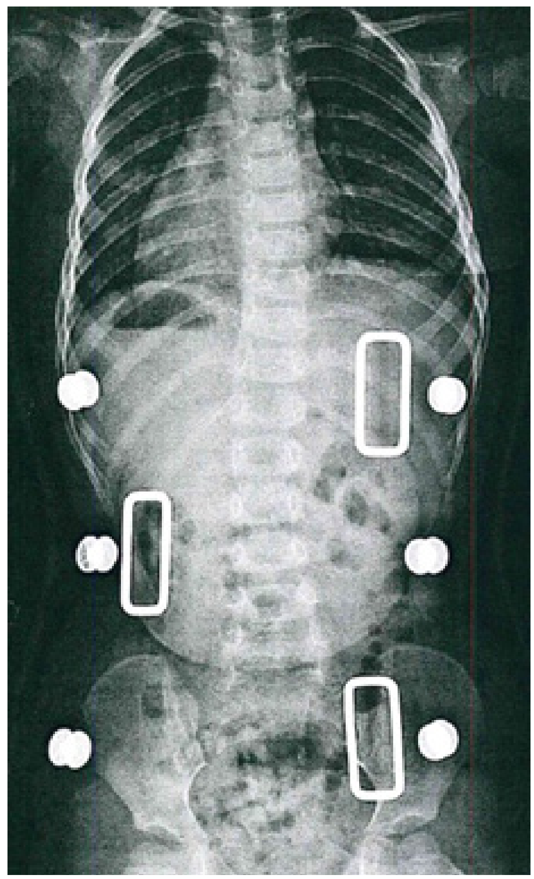

Figure 4. AP X-Ray Before Removing Final Brace

Parent Teaching Implications for the Care of the Mehta Cast and TLSO Brace

There are several recommendations that are given to the patient's caregiver to aid in proper care of the Mehta Cast and TLSO Brace.

- Try to keep the cast from getting wet, which may involve giving the child a sponge bath.
- It is recommended to wrap the cast with a plastic food wrap while eating, bathing or going to the restroom, in order to keep the cast dry [31].
- Be careful of things falling inside the cast, such as food or small toys. Not only will it be difficult to remove these objects, but it can cause skin irritation [32].
- Using loose clothing or getting a larger clothing size will be beneficial because the clothes have to fit over the cast and brace, this will make

the child more comfortable.

- It is important to be observant for fall prevention because the cast is heavy and at first it may cause the child to feel unbalanced or have difficulty walking [32,33].
- Small meals are better to prevent bloating that can cause the child to be uncomfortable due to their abdominal area "poking" through the hole in the cast.
- Avoid lotions or creams while wearing a cast as they will soften the skin and make it more easily damaged from the edges of the cast [31].
- Moleskin petals, which are a soft spongy material can be placed around the edges of the cast to prevent irritation to the skin. Typically, they are folded around the edges of the cast, and will adhere with a sticky tape on the underside of each petal [28].
- Be cautious of the amount of direct sunlight the child is exposed to because it can cause the patient to sweat, therefore causing a wetness inside the cast resulting in bacteria forming, an odor, or even itching [28].
- Have the child change positions when lying down, this will help to prevent long-time pressure injuries from the cast or brace rubbing in the same spot [28].
- It is recommended in the first week of cast placement to check the child's arms and legs to evaluate for changes in skin temperature, changes in skin color, inability to move, or numbness. These issues could potentially mean the that cast is on too tight and will need to be evaluated by the physician [31].
- If an unpleasant odor is coming from the cast, this could mean a possible skin infection and should be reported to the physician [31].
- If the patient experiences a fever of over 101 degrees it should also be reported to the physician as the patient could be experiencing an infection [31].
- It is also recommended to clean the inside and outside of the TLSO brace weekly with rubbing alcohol or soap and water [32].

Conclusion

Currently, the now almost six-year-old patient is measuring a 10.6-degree stable dextroscoliotic curvature. Additionally, she is monitored every six months to evaluate for the potential of an increase in her dextroscoliosis. She has not had any torticollis issues since her original treatment, which proves the vitality of her success is due to early treatment. There is clear evidence showing an early detection and treatment of torticollis and scoliosis will prove a greater chance of obtaining a "cure" [34]. To my scoliosis warrior, "the best view comes after the hardest climb" [35] (See Figure 5)

Figure 5. After Treatment - Child at Age 5

Questions

1. Scoliosis is defined as a spinal deformity with a lateral curvature of the spine greater than:
a. **10 Degrees**
b. 15 Degrees
c. 20 Degrees
d. 30 Degrees

2. The acronym PACs stands for:
a. Picture Availability Communication Systems
b. Picture Archiving Collaboration Systems
c. **Picture Archiving Communication Systems**
d. Picture Availability Collaboration Systems

3. Torticollis best refers to twisted of which part of the body:
a. Lumbar Area
b. **Neck Area**
c. Small Bowel
d. Thoracic Area

4. Scoliosis has the potential to impact other parts of the body if left untreated:
a. **True**
b. False

5. The most common x-ray done to evaluate for scoliosis is:
a. **AP**
b. Lateral
c. Decubitus
d. Oblique

6. Mehta cast has shown to be the best treatment option for which type of scoliosis:
a. Neuromuscular
b. Congenital
c. **Idiopathic**
d. Both A and B

7. The goal of a Mehta cast is to cure severe cases of scoliosis:
a. True
b. **False**

8. The lumbar spine comprised how many vertebral bodies:
a. Seven
b. Twelve
c. **Five**
d. Four

9. The sacrum comprises how many fused bones, typically:
a. Two
b. Three
c. Four
d. **Five**

10. The coccyx comprised how many fused bones, typically:
a. Two
b. Three
c. **Four**
d. Five

11. Facet joints for rib articulation is a unique feature for which part of the spine:
a. Cervical
b. **Thoracic**
c. Lumbar
d. Sacrum

12. Transverse foramen for passage of the vertebral vessels is a unique feature for which part of the spine:
a. **Cervical**
b. Thoracic
c. Lumbar
d. Sacrum

13. How many vertebrae are in the body:
a. **24 plus the sacrum and coccyx**
b. 33 plus the sacrum and coccyx
c. 17 plus the sacrum and coccyx
d. 19 plus the sacrum and coccyx

14. Approximately how many children are diagnosed with scoliosis in the U.S.:
a. 12%
b. 20-25%
c. **2-5%**
d. 10-15%
15. It is important to attain x-rays throughout the cast and brace journey to ensure a decrease in lateral curvature of the spine:
a. **True**
b. False
16. Sponge baths might be necessary to avoid wetness to the cast:
a. **True**
b. False
17. An abnormal lateral curvature of the spine greater than 60 degrees may require surgery:
a. **True**
b. False
18. A moderate case of scoliosis denotes a lateral curvature of:
a. 0-10 degrees
b. 10-15 degrees
c. **20-40 degrees**
d. 40-60 degrees
19. A severe case of scoliosis denotes a lateral curvature of:
a. More than 10 degrees
b. More than 20 degrees
c. More than 30 degrees
d. **More than 40 degrees**
20. The first line of treatment for Torticollis is:
a. Surgery
b. Medication
c. **Physical Therapy**
d. None of the Above
21. A brace is used mainly for stability or to prevent the scoliosis from worsening:
a. **True**
b. False
22. How often will a cast typically get changed due to patient growth:
a. Every month
b. **Every 2-3 months**
c. Every six months
d. Every year
23. Patients may suffer from imbalance issues before being diagnosed with scoliosis:
a. **True**
b. False
24. All pediatric patients undergoing a cast will have five different casts over a year span:
a. True
b. **False**
25. What term is used to describe muscles that are not stable and cause an infant to have difficulty maintaining good posture:
a. Hypertonia
b. **Hypotonia**
c. Hypertrophy
d. Hypotrophy
26. Moleskin petals may be utilized to prevent:
a. **Skin breakdown**
b. Further curvature
c. The cast from moving
d. The cast from getting wet
27. The three main types of scoliosis are:
a. Idiopathic, Congenital, Neurogenic
b. Idiopathic, Iatrogenic, Neuromuscular
c. **Idiopathic, Congenital, Neuromuscular**
d. Idiopathic, Iatrogenic, Neurogenic
28. The Mehta cast is made of plaster or fiberglass:
a. **True**
b. False
29. Mehta cast is most effective in children under the age of:
a. Two
b. **Four**
c. Six
d. Eight
30. Mehta casts are waterproof:
a. True
b. **False**

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