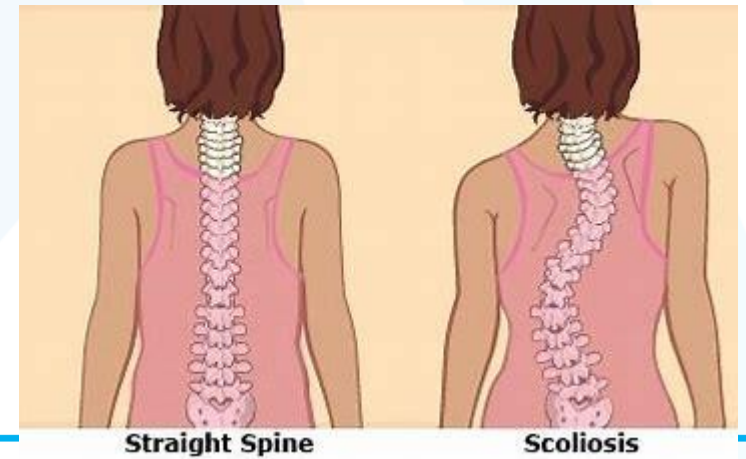




# Scoliosis



- Scoliosis is a three-dimensional abnormality that occurs when the spine becomes rotated and curved sideways.
- Scoliosis is any abnormal sideways curvature of the spine measuring at least 10 degrees on an x-ray. While scoliosis is not a disease, in rare cases it can be caused by a disease. More often, however, scoliosis develops from an unknown cause during adolescence or from spinal degeneration during adulthood.

- Most often this condition has no known cause, in which case it is called idiopathic scoliosis.
- While the cause is unknown, idiopathic scoliosis does tend to run in families. The specific genes involved have not all been identified yet, and there could be factors beyond genetics as well.
- Some people mistakenly think that carrying heavy backpacks or sleeping on the side could cause scoliosis, but that is not the case.
- About 3% of the population is estimated to have idiopathic scoliosis.



# Types of Idiopathic Scoliosis

- Typically, idiopathic scoliosis is categorized by the age at which the deformity developed:
  1. Infantile idiopathic scoliosis: develops from birth to 3 years old
  2. Juvenile idiopathic scoliosis: develops from 4 to 9 years old
  3. Adolescent idiopathic scoliosis: develops from 10 to 18 years old
- Adolescent scoliosis comprises approximately 80% of all idiopathic scoliosis cases. Adolescence is when rapid growth typically occurs, which is why the detection of a curve at this stage should be monitored closely for progression as the child's skeleton develops.

Idiopathic means a condition is of unknown cause. As such, idiopathic scoliosis technically cannot be diagnosed until other types of scoliosis are ruled out.

Other types of scoliosis could include:

1. **Congenital scoliosis.** This type of scoliosis is present from birth and is the result of the spine not forming properly.
2. **Neuromuscular scoliosis.** Many types of neuromuscular conditions can lead to muscle problems in the back that result in scoliosis. A few examples include cerebral palsy and myelodysplasia.
3. **Degenerative scoliosis.** Also called adult onset scoliosis, this type of degenerative scoliosis results from the deterioration of the facet joints in the spine.
4. **Nonstructural scoliosis.** This type of scoliosis, also known as functional scoliosis, occurs due to a temporary cause that only affects lateral curvature without spinal rotation. For example, a difference in leg heights could potentially cause a sideways curve in the spine that is corrected with a shoe insert.

Scoliosis will usually be classified as idiopathic if it was not present at birth and cannot be traced to a neuromuscular, degenerative, or other cause

# Scoliosis Symptoms

- A mild scoliosis curve can go unnoticed to the untrained eye. However, if the curve progresses, various signs and symptoms can become obvious.
- **Common Early Signs of Scoliosis**
- Oftentimes scoliosis is first suspected when someone notices something slightly off and comments. Some examples could include:
- **Clothes fit awkwardly or hang unevenly.** A parent, friend, or even the person with scoliosis might notice that a shirt or blouse appears uneven, which could be cause for further investigation.

- **Sideways curvature observed while in bathing suit or changing.** For instance, a parent could first notice the sideways curvature in an adolescent's back while at the pool or beach.
- Even if a newly discovered asymmetry appears minor, it should be checked by a doctor because scoliosis is easier to treat when caught early.



- **Symptoms of Moderate or Severe Scoliosis**

- Only about 10% of people with idiopathic scoliosis have a curve that progresses beyond mild and needs treatment. If that progression happens, the deformity becomes more obvious to other people and more likely to cause noticeable symptoms.
- Some of the more common symptoms present in moderate or severe scoliosis could include:
- **Changes with walking.** When the spine abnormally twists and bends sideways enough, it can cause the hips to be out of alignment, which changes a person's gait or how they walk. The extra compensating that a person does to maintain balance for the uneven hips and legs can cause the muscles to tire sooner. A person might also notice that one hand brushes against a hip while walking but the other does not.



- **Reduced range of motion.** The deformity from spinal twisting can increase rigidity, which reduces the spine's flexibility for bending.
- **Trouble breathing.** If the spine rotates enough, the rib cage can twist and tighten the space available for the lungs. Bone might push against the lungs and make breathing more difficult.
- **Cardiovascular problems.** Similarly, if the rib cage twists enough, reduced spacing for the heart can hamper its ability to pump blood.



- **Pain.** If curvature becomes severe enough, back muscles could become more prone to painful spasms. Local inflammation may develop around the strained muscles, which can also lead to pain. It is possible for the intervertebral discs and facet joints to start to degenerate due to higher loads.
- **Lower self-esteem.** This symptom is commonly overlooked or minimized by outside observers, but it can be a significant factor for people who have a noticeable spinal deformity. Especially for adolescents who want to fit in with their friends, it can be stressful and depressing to look different, have clothes fit unevenly, or wear a noticeable back brace that may be uncomfortable or limit activity.

- It is possible but highly unlikely for scoliosis to ever progress to the point of causing death. Typically, a person would have access to a surgical solution before that type of deformity could set in.
- **Possible Back Pain Symptoms**
- There is some controversy regarding scoliosis as a cause of back pain. Scoliosis by itself is typically not thought to cause pain.<sup>2</sup> If a child or adolescent with scoliosis presents with back pain, the clinician will look for some other underlying cause to explain the pain.
- That being said, many people who have idiopathic scoliosis report pain they feel is caused by the curve itself. There is conflicting research on that point, but the current trends in literature seem to point to more back pain reported in scoliosis patients compared to the general population.

# Types of Curves

- **Common Types of Curves**
- A scoliosis curve usually looks a bit like a backward C shape and involves the spine bending sideways to the right, which is also called dextroscoliosis. Sideways spinal curvature on the left side of the back is more like a regular C shape and called levoscoliosis. Here are four common types of scoliosis curves:
- **Right thoracic curve.** If a straight line were drawn down the center of the back, this curve bends to the right side of the upper back (thoracic region).

- **Right thoracolumbar curve.** This curve bends to the right side—starting in the upper back (thoracic) and ending in the lower back (lumbar).
- **Right lumbar curve.** This curve bends to the right side—starting and ending in the lower back.
- **Double major curve.** Typically, a double curve involves right thoracic curve on top and left lumbar curve on bottom. People who have a double major curve may initially have a less obvious deformity because the two curves balance each other out more.
- Several other types of curves are possible, such as a left thoracic curve. There have also been rare scoliosis cases with triple curves.

**C-shaped  
curve to  
the right**



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**C-shaped  
curve to  
the left**



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**S-shaped  
curve**

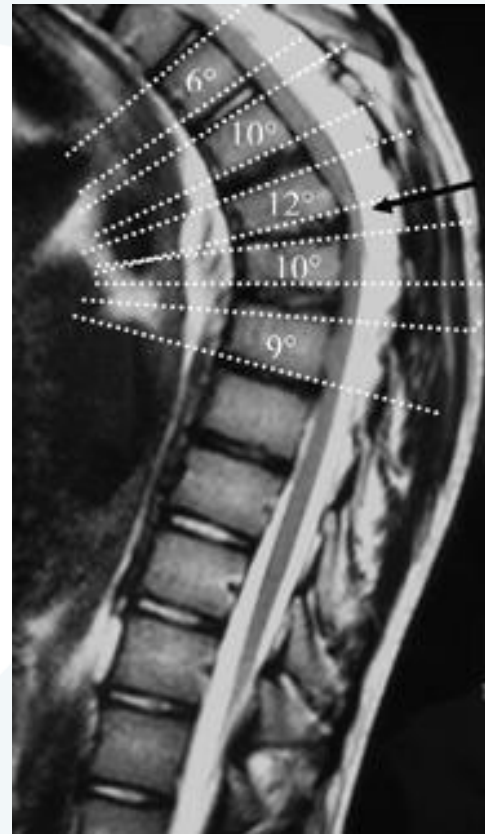


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# Scoliosis Diagnosis

- Idiopathic scoliosis is usually first identified during a regular checkup with a pediatrician or a routine screening at school; or perhaps a parent or teacher happens to notice and comments on the possible sideways curvature of the spine.
- An official diagnosis of idiopathic scoliosis requires X-ray confirmation of the abnormal lateral curvature and spinal rotation, as well as ruling out other possible causes for the deformity (such as Scheuermann's disease, juvenile disc disorder, or ankylosing spondylitis).





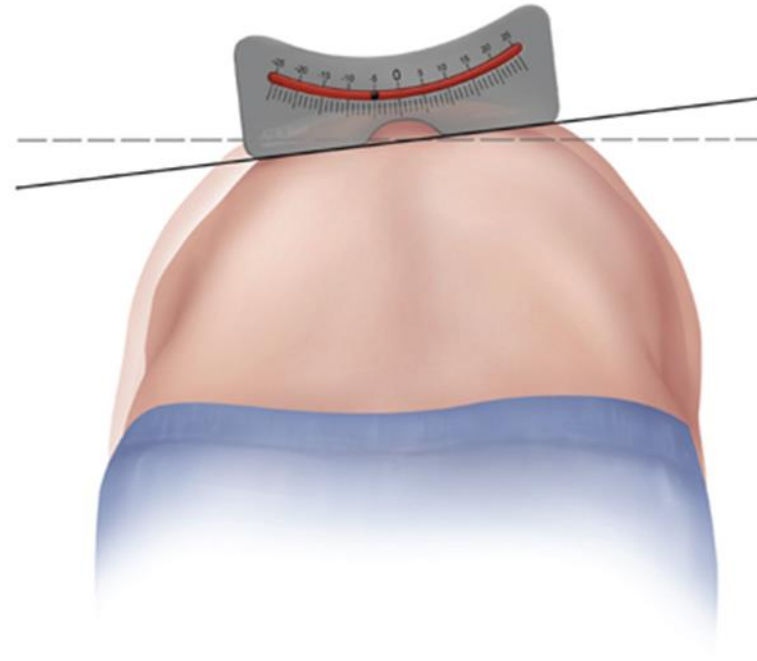


# Adam's Forward Bend Test

- This test involves a healthcare professional observing the patient bending forward at the waist 90 degrees with arms stretched toward the floor and knees straight. From this position, most scoliosis signs that present as asymmetry are clearly visible in the spine and/or trunk of the body, such as:
  - One shoulder or shoulder blade is higher than the other
  - Rib cage appears higher on one side (also called a rib hump)
  - One hip appears higher or more prominent than the other
  - The waist appears uneven
  - The body tilts to one side
  - One leg may appear shorter than the other



FIGURE 1. Adams forward-bending test



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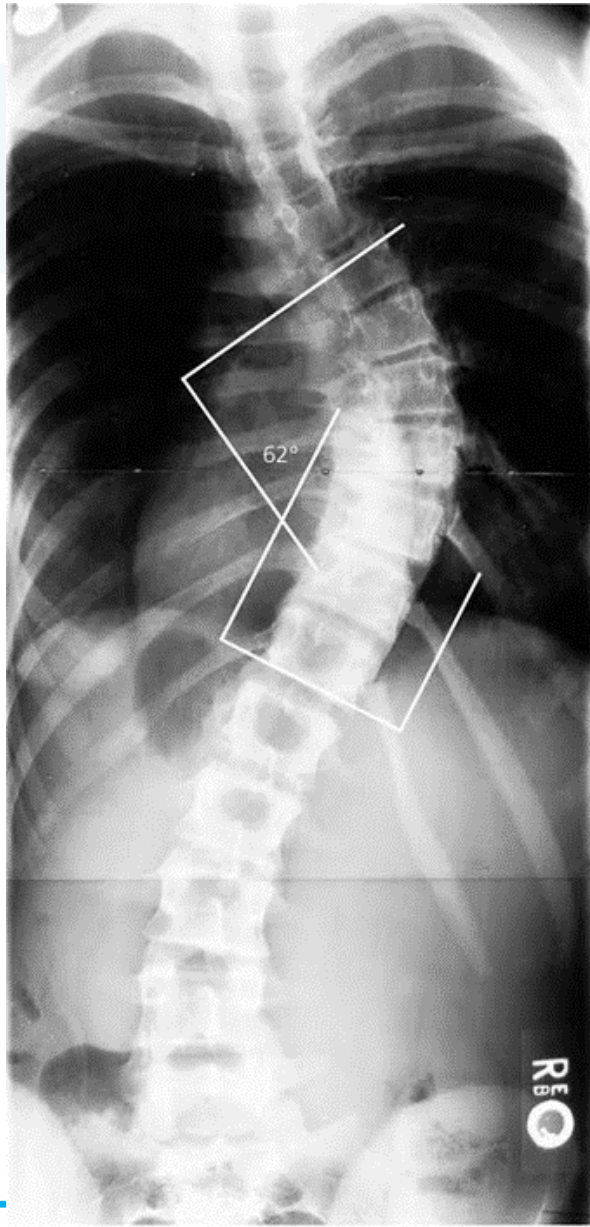
- **Scoliometer to Measure Spine Rotation**

- As part of the forward bend test, the clinician might use a scoliometer, also called an inclinometer, to estimate the angle of trunk rotation (ATR). While the patient is still bending forward, the clinician can put the scoliometer flat on the back in the area or areas where the asymmetry looks the greatest.
- As a general rule, if an ATR of at least 5 degrees is recorded, the patient will either be scheduled for a follow-up exam or referred to a doctor who can image the back for more accurate scoliosis testing.<sup>[1](#),[2](#)</sup> X-ray imaging is needed to measure the degree of the curve and confirm scoliosis.

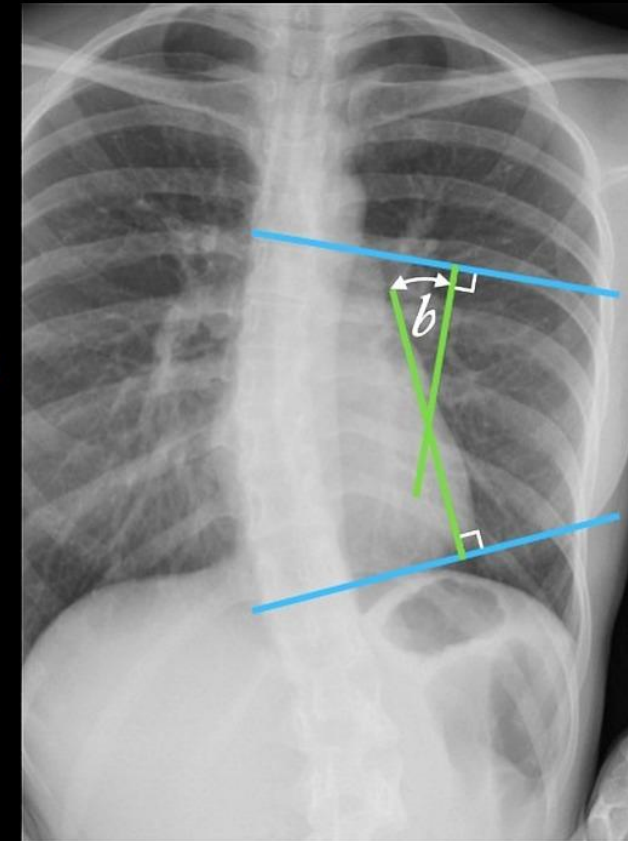
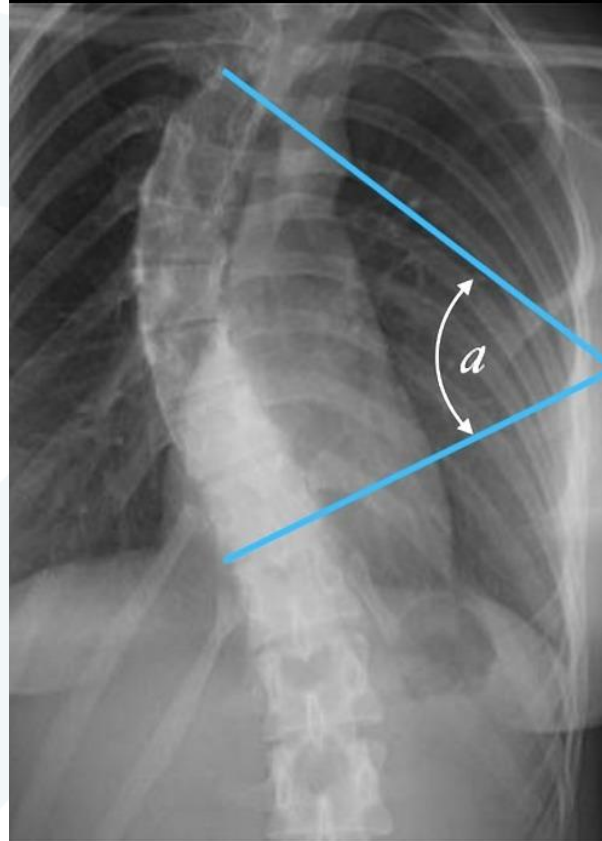
- **Cobb Angle Measurement**

- The lateral curve of scoliosis is described by the Cobb angle. Using an X-ray of the full spine, the Cobb angle is found by drawing a perpendicular line from the spine's most-tilted vertebra above the sideways curve's apex and a second perpendicular line from the most-tilted vertebra beneath the apex. The angle formed where those two lines meet is the Cobb angle.
- A Cobb angle of at least 10 degrees is typically considered the borderline for a scoliosis diagnosis.





## Cobb angle





# Key Components of a Scoliosis Diagnosis

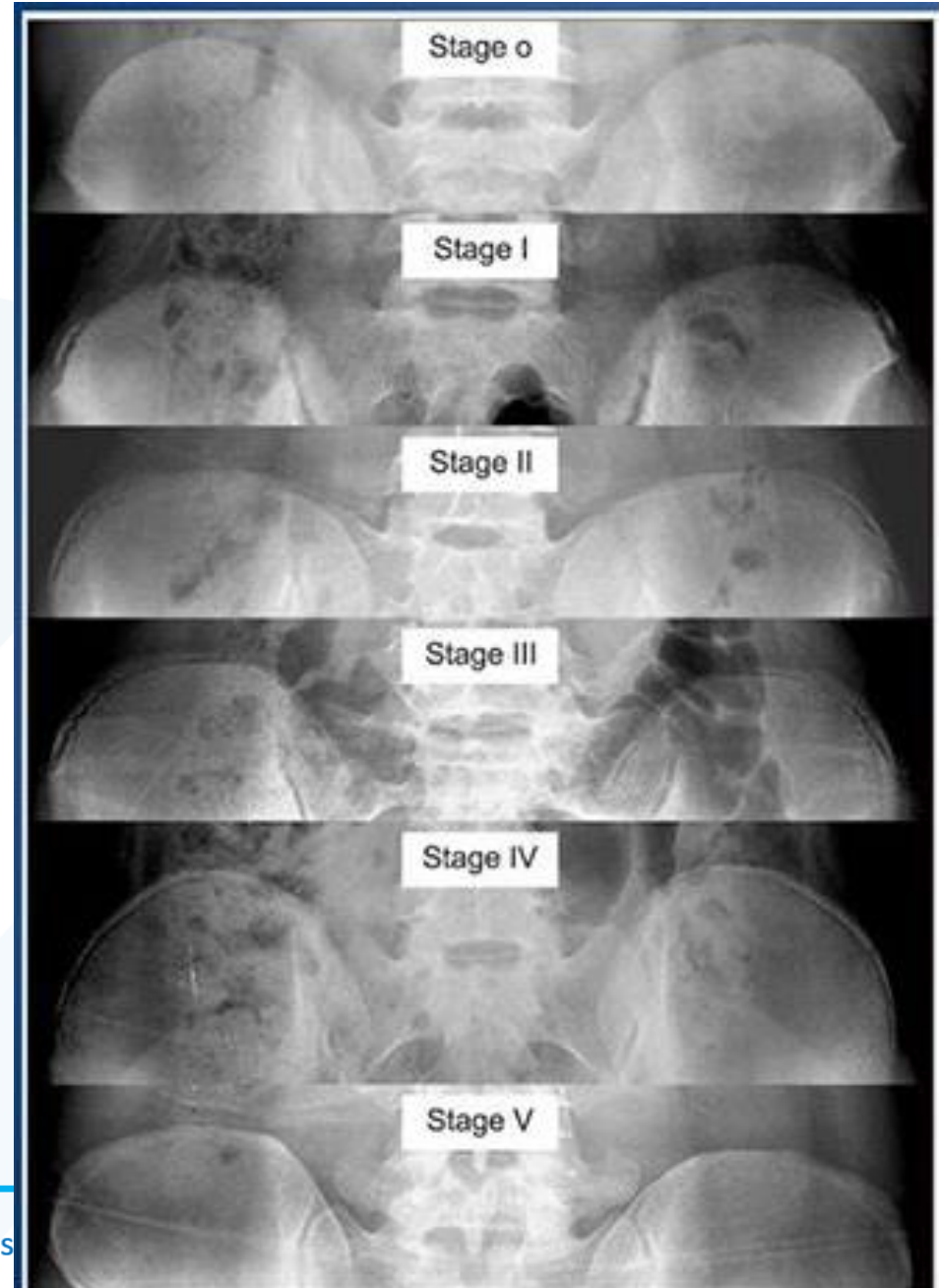
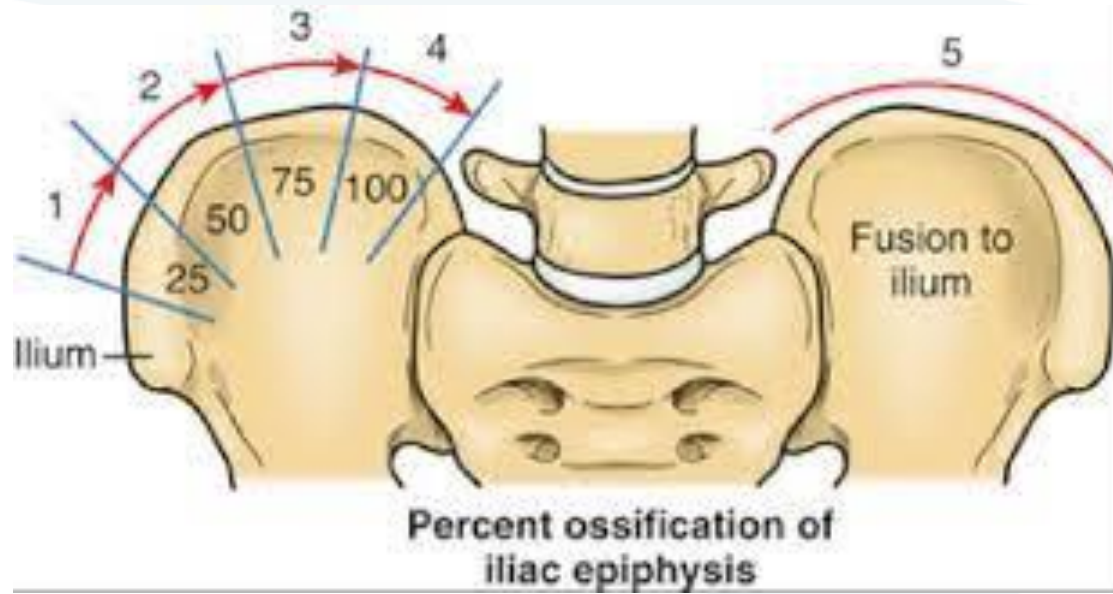
When diagnosing idiopathic scoliosis, there are 3 key components to take into consideration:

- **Lateral curvature.** The lateral (sideways) curvature of the spine is measured by the Cobb angle. The bigger the Cobb angle, the greater the spinal deformity.
- **Axial rotation.** In addition to the sideways curvature, the spine abnormally rotates along the vertical axis. Spinal rotation can affect rib rotation, as well as curve rigidity.

- **Skeletal maturity.** Often estimated by the Risser sign (amount of calcification at the hip bone's ridged top as seen on the same X-ray as the Cobb angle), the amount of skeletal maturity remaining is critical to making scoliosis treatment decisions in children and teens.

Understanding these components of a scoliosis diagnosis can help the medical team evaluate the severity of the curve, likelihood for progression, and which treatment options could be best.





# Treatment

Treatment options for idiopathic scoliosis could include:

- **Observation.** Typically, a doctor will advise observation for a scoliosis curve that has not yet reached 15 degrees. Every 4 to 6 months, the doctor will take another X-ray of the spine to see if the scoliosis is progressing or not.
- **Bracing.** If the scoliosis has progressed past 20 or 25 degrees, a back brace could be prescribed to be worn until the adolescent has reached full skeletal maturity. The goal of bracing is to prevent the curve from getting worse and to avoid surgery.

- **Surgery.** If the curve continues to progress despite bracing, surgery could be considered. The most common surgical option for scoliosis today is a posterior spinal fusion, which can offer better corrections with fewer fusion levels (preserving more back mobility) than what was done in years past.

Approximately 90% of people identified with idiopathic scoliosis have curves that never progress enough to require bracing or surgery.

# Scoliosis Treatment

- If scoliosis starts to cause a noticeable deformity or is at high risk of doing so, a doctor might prescribe a brace to prevent the curve from getting any worse. Typically, a brace is worn until the adolescent has reached full skeletal maturity.
- Knowing if a person's scoliosis curve is likely to worsen is crucial to developing a treatment plan. Bracing is a major time commitment and uncomfortable for adolescents—both physically and emotionally—and is usually not prescribed unless the curve is at significant risk for progressing.

# Risk Factors for Scoliosis to Progress

- **Large lateral curve.** In general, the larger the curve's Cobb angle, the more likely it will progress. For example, if two adolescents with scoliosis have the same amount of skeletal growth remaining but one has a 20-degree curve and the other already has a 30-degree curve, the person with the larger curve is likely to experience more curve progression in the future.
- **Significant skeletal growth remaining.** If scoliosis has been identified and the adolescent has some skeletal growth left, there is potential for the spine's lateral curve(s) to grow and worsen. The more skeletal growth remaining, the greater the risk for curve progression.

- **Female sex.** While boys and girls are about as likely to have mild scoliosis, girls are more than 7 times as likely to have their spinal curves progress to moderate or severe scoliosis and require treatment.
- **Curve in thoracic spine.** A scoliosis curve located in the upper back is more likely to progress than a curve located lower in the back.

Once the risk factors for idiopathic scoliosis progression are assessed, treatment decisions can be made.



# Choosing Observation vs. Bracing

- About 90% of idiopathic scoliosis cases are mild and only require observation. Typically, observation is done by a doctor every 4 to 6 months until the adolescent has reached full skeletal maturity.

However, a brace for scoliosis will generally be considered if either of the following occurs to the curve's Cobb angle:

- Progresses past 25 degrees with significant skeletal growth remaining
- Progresses at least 5 degrees during any 4- to 6-month period

If the curve has become big or is progressing rapidly, the next step is usually bracing treatment in an effort to stop the curve's progression.



# Brace Options

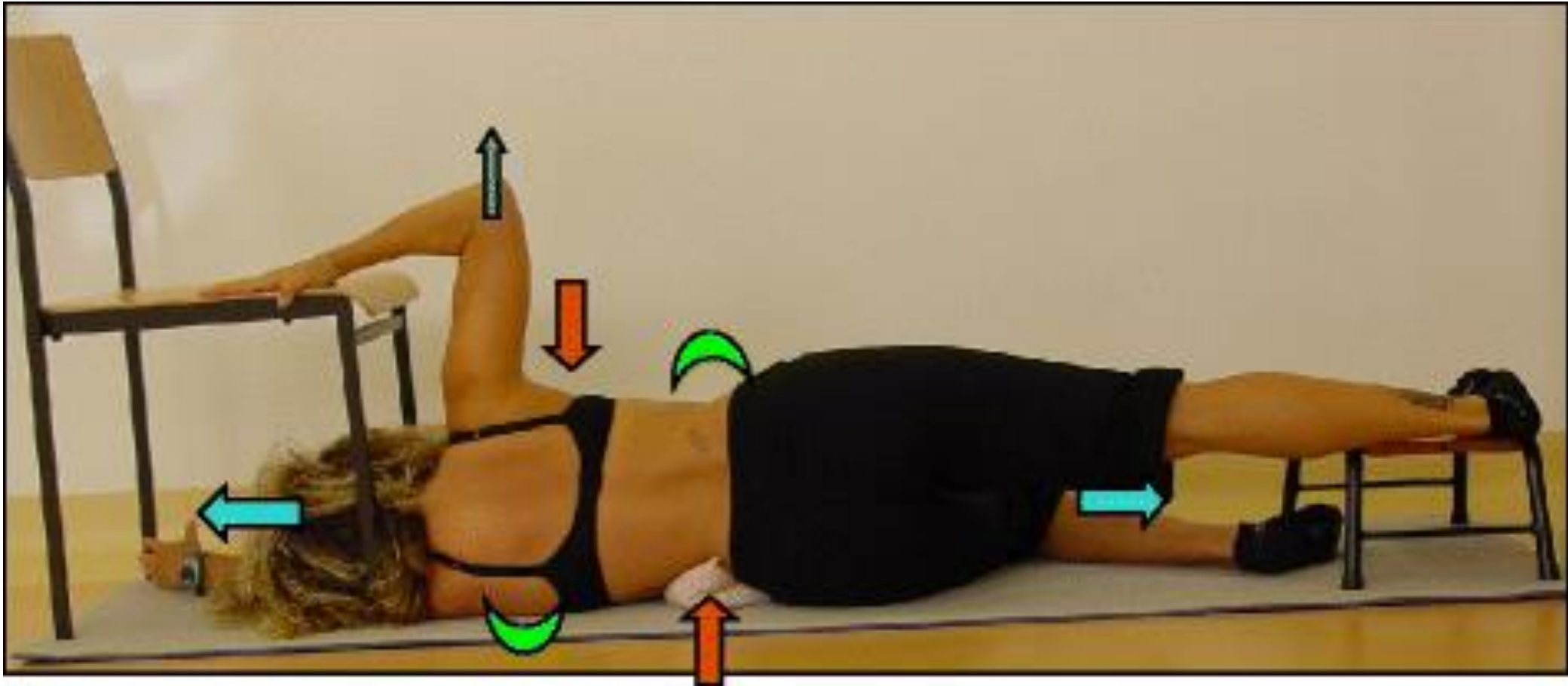
There are two general treatment options for scoliosis bracing:

- **Full-time bracing.** These braces are designed to be worn 16 to 23 hours a day. The goal is to wear them all the time with exceptions for bathing, skin care, and exercising.
- **Nighttime bracing.** These braces use hyper-corrective forces (which put the body out of normal balance and cannot realistically be applied while a person is standing and/or performing daily activities) and are to be worn at least 8 hours a night.
- Choosing between full-time bracing and nighttime bracing can depend on size and location of curves, as well as what the patient is willing to do. Some studies have found that nighttime bracing tends to be more effective because patients are more likely to wear a brace at night as prescribed, but other studies have found that full-time bracing—when adhered to as directed—could work even better.





- There is no current consensus in the medical community regarding whether full-time or nighttime bracing works better than the other. For curves that are less than 35 degrees, recommendations tend to be for either nighttime or full-time bracing as appropriate. For curves that are at least 35 degrees, recommendations tend to be for full-time bracing.
- **Other Nonsurgical Treatments Unproven**
- While some people claim that treatments such as physical therapy and manual manipulation can help stop the progression of scoliosis, there is little scientific evidence to support these claims. Bracing is currently the only nonsurgical treatment that has been proven to reduce the natural progression of idiopathic scoliosis curves.
- However, if given the okay by a doctor, exercise is healthy for people with scoliosis and helps keep the back strong and flexible.



## When Bracing Fails

- Sometimes an idiopathic scoliosis curve continues to progress despite bracing. If this happens and the curve progresses past 40 or 50 degrees, spinal fusion surgery may be considered.

# Scoliosis Surgery

## 3 Goals of Scoliosis Surgery

- **Stop the curve's progression.** When scoliosis requires surgery, it is usually because the deformity is continuing to worsen. Therefore, scoliosis surgery should at the very least prevent the curve from getting any worse.
- **Reduce the deformity.** Depending on how much flexibility is still in the spine, scoliosis surgery can often de-rotate the abnormal spinal twisting in addition to correcting the lateral curve by about 50% to 70%. These changes can help the person stand up straighter and reduce the rib hump in the back.
- **Maintain trunk balance.** For any changes made to the spine's positioning, the surgeon will also take into account overall trunk balance by trying to maintain as much of the spine's natural front/back (lordosis/kyphosis) curvature while also keeping the hips and legs as even as possible.

In addition, any adjustment of the spine must also consider the possible effect on the spinal cord. The health of the spinal cord must be monitored throughout the surgery.

## Surgical Options for Idiopathic Scoliosis

- **Fusion.** This spinal surgery permanently fuses two or more adjacent vertebrae so that they grow together at the spinal joint and form a solid bone that no longer moves. Modern surgical approaches and instrumentation—rods, screws, hooks, and/or wires placed in the spine—have enabled spinal fusion surgeries to achieve better curvature correction and faster recovery times than in the past.
- An advantage to spinal fusion surgery is that it has a long-term record of safety and efficacy for treating scoliosis. While a drawback to the procedure is that any fused vertebrae will lose mobility, which can limit some of the back's bending and twisting, today's spinal fusions tend to fuse fewer vertebrae and maintain more mobility than in the past.



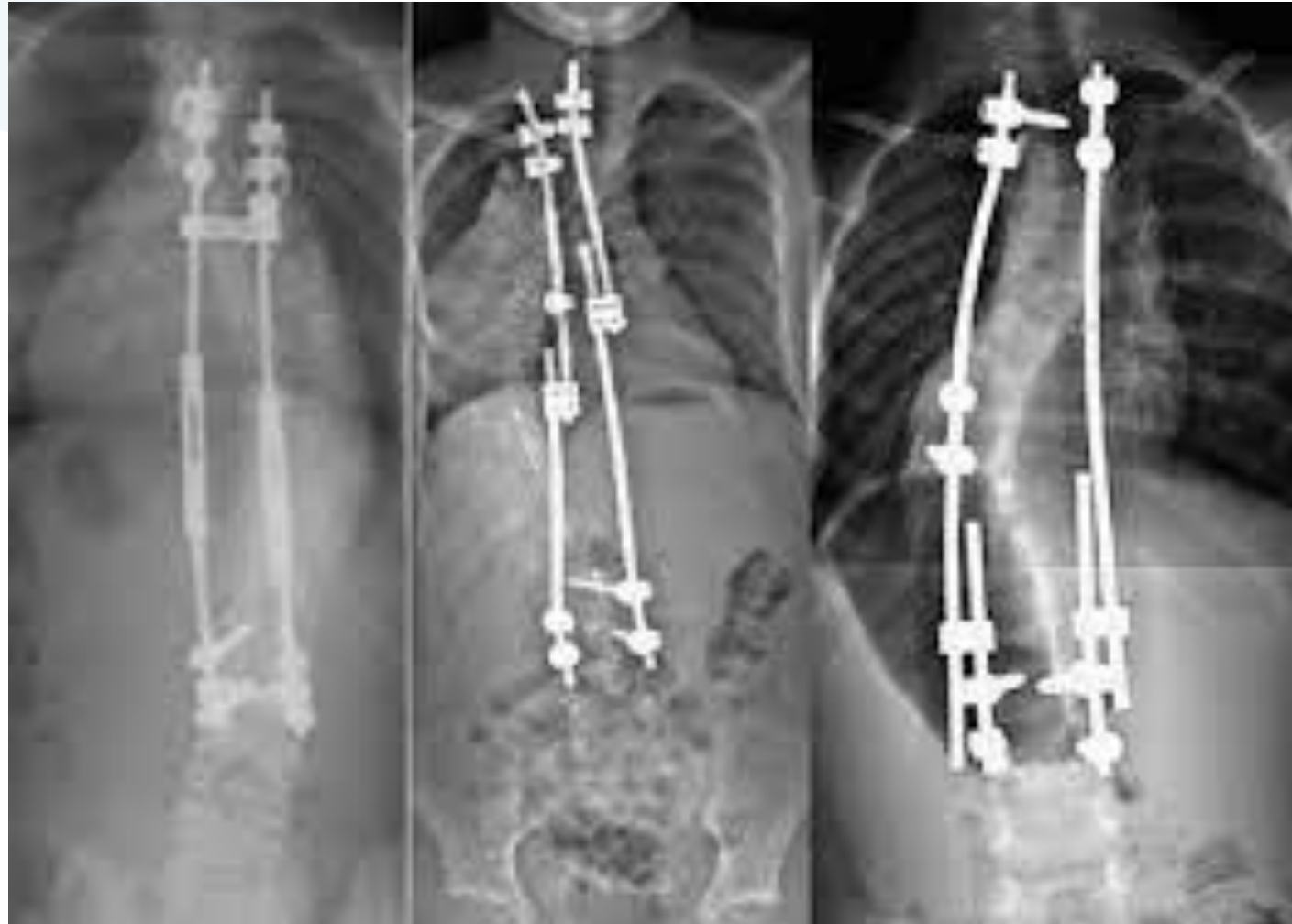


- **Growing systems (to delay fusion).** Rods are anchored to the spine to help correct/maintain the spine's curvature while the child grows. Every 6 to 12 months, the child has another surgery to lengthen the rods to keep up with the spine's growth. Once the patient is close enough to skeletal maturity, the patient will usually get a spinal fusion.
- If a spinal fusion is done at too young of an age (typically younger than age 10 in girls or less than 12 in boys), that could leave less room for the lungs to develop in addition to the child having an unusually short trunk compared to the limbs. To avoid these complications, the growing systems method helps guide the spine as it grows, preventing the curve from worsening as the spine matures and eventually becomes ready for a fusion if needed.





- **Fusionless.** Current fusionless surgery methods employ growth modulation on the spine similar to what has been done in the past to treat unequal leg heights in growing children. The theory is that by putting constant pressure on a bone, it will grow slower and denser. By applying such pressure on the outer side of a spinal curve, the surgeon aims to slow or stop the growth of the curve's outer side while the curve's inner side continues to grow normally. As the spine continues to grow in this manner, the lateral curvature should reduce as the spine becomes straighter.
- One fusionless method uses a vertebral tethering system, which involves placing screws on the outer side of the curve and then pulling them taut with a cord so the spine straightens. Compared to spinal fusion, fusionless surgery has the potential benefit of retaining more spinal mobility. However, this is a newer approach and long-term data about the risks and benefits are not yet available.
- For an adolescent or young adult opting for scoliosis surgery today, by far the most commonly performed surgery is a spinal fusion.



# Occupational Therapy for the Treatment of Scoliosis

The Therapist will evaluate all the daily activities, with the optimum need for manual work and all of the posture during that table work.

- **Posture:** The Therapist will evaluate the correct posture to complete the task during all manual work or even the table work.
- **Assessment:** The Therapist will then assess your manual's tolerance and the table for getting the optimum duration.

- **Evaluation:** The Therapist will then be evaluated for Scoliosis patients periodically and will also intervene if the symptoms are getting exaggerated and anatomical deformity has worsened.
- **Intervention:** Occupational Therapist will be advisable to change the job or even change the hours of the time table for work so that the scoliosis patient can always cope with it. Therapists may even demand to have eliminated manual labor as well.
- **Support:** Therapists may get to modify all the treatment and advise touse braces for their patients that are suffering from Scoliosis. *Occupational therapists* may be prescribed as a piece of equipment for supporting the activities like a cane or even the walker.



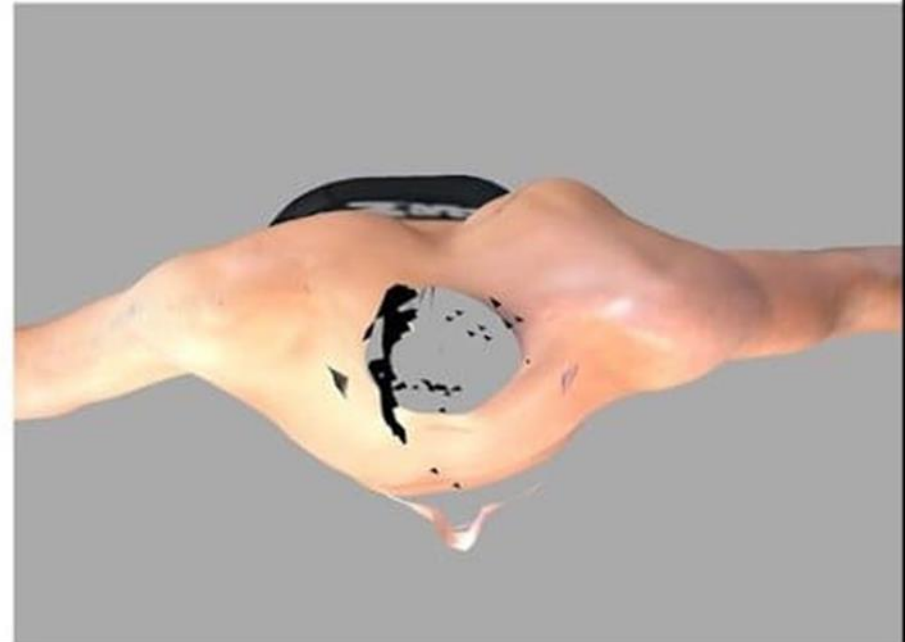
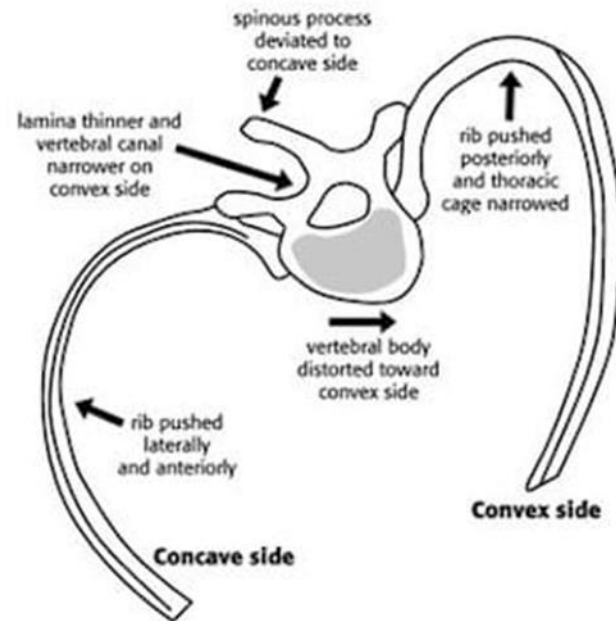




**Vertebrae  
curve and  
rotate**

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## Typical Top View of a Scoliosis Patient

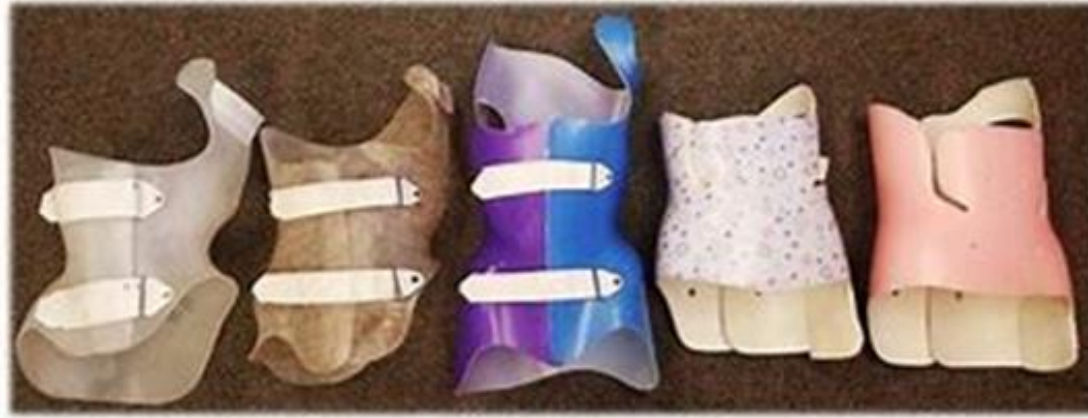


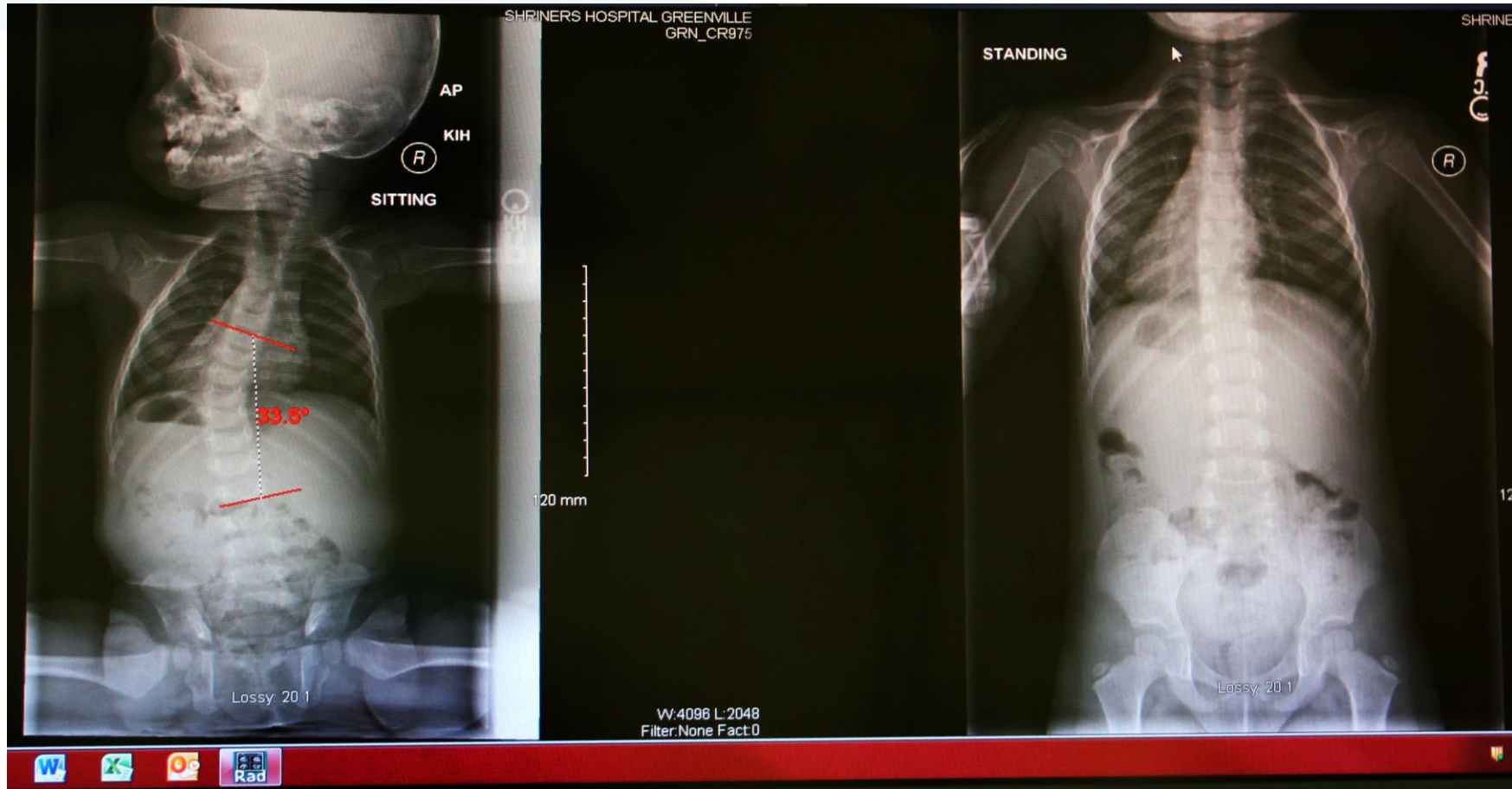


## Milwaukee Brace



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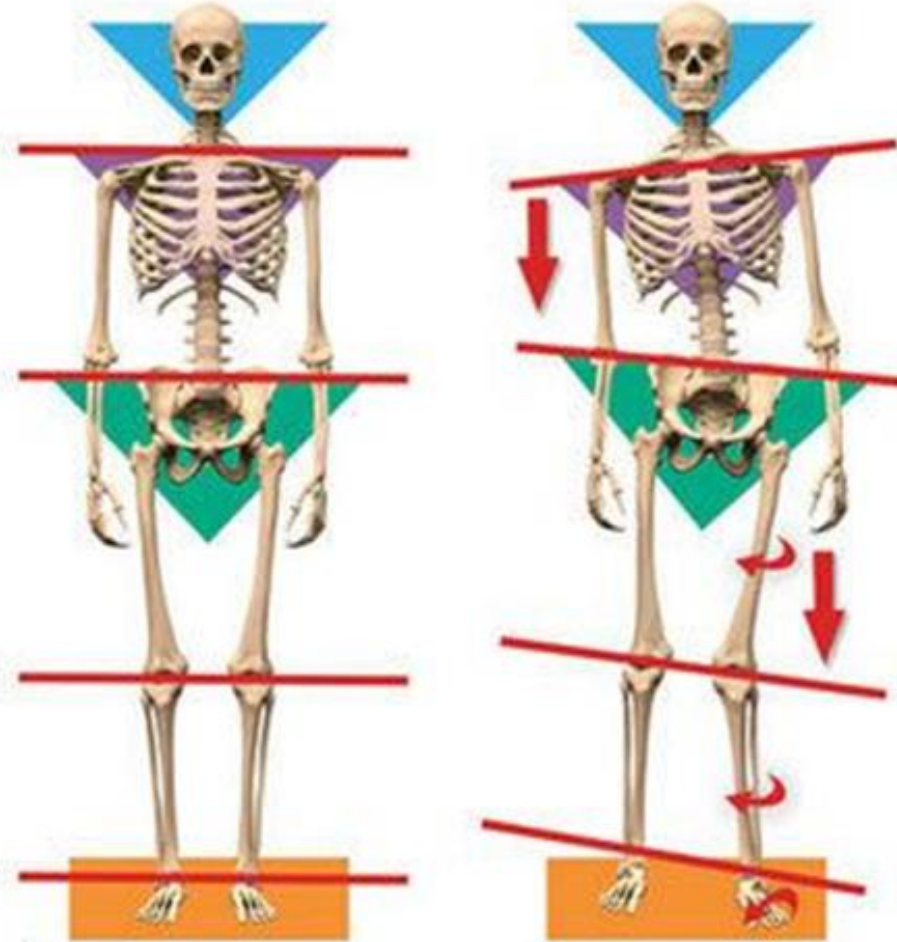
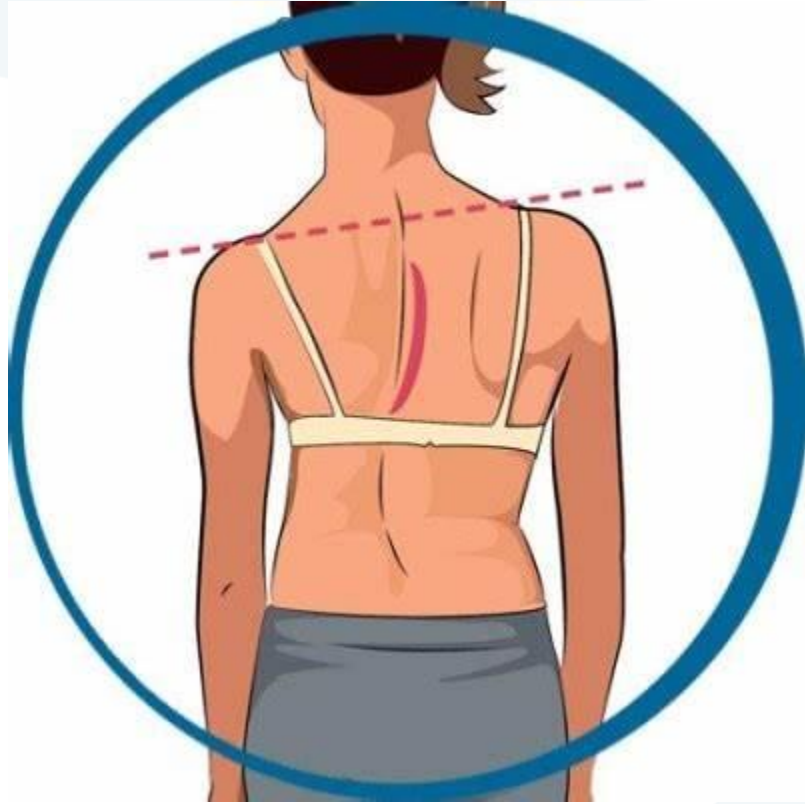


Fig. 2

# Thank you