

Exercise Considerations for Adolescents and Adults with Scoliosis

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My Story



Objectives

- ▶ Discuss the diagnosis, pathomechanics, and treatments for scoliosis
- ▶ Discuss research regarding scoliosis and sports/fitness
- ▶ Describe a simple evaluation to determine curve type
- ▶ Explain the focus of fitness training for clients with scoliosis, whether adolescents or adults





► **What is scoliosis?**

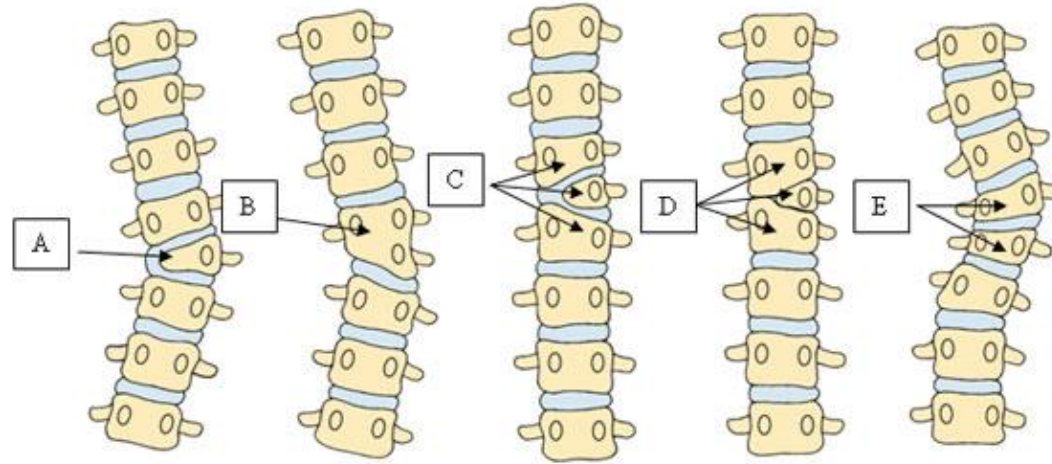
What is scoliosis?

- ▶ Definition:
 - ▶ Radiographically a lateral curvature of the spine greater or equal to 10 degrees with **rotation**
 - ▶ Complex change of the spine and trunk
 - ▶ Rotation
 - ▶ Lateral shift
 - ▶ Hypokyphosis/flat back
- ▶ Structural vs. Functional



Structural Scoliosis

- ▶ Structural Scoliosis
 - ▶ Most structural cases are idiopathic (75-80%)
 - ▶ Neuromuscular (5-7%)
 - ▶ Congenital (10%)
 - ▶ Recklinghausen (Neurofibromatosis) (2-3%)
 - ▶ Others (Marfans, Tumors)



Adolescent Idiopathic Scoliosis (AIS)

(SOSORT 2013)

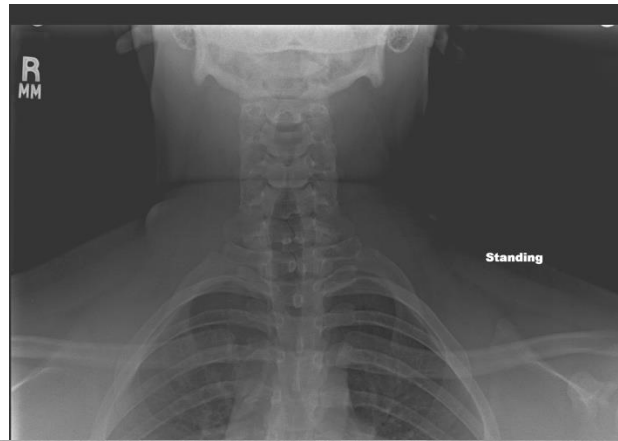
- ▶ Diagnosed between age 10 to 18
- ▶ Most common type of scoliosis
 - ▶ Out of 100 children...
 - ▶ 3-5 will be diagnosed
 - ▶ 1-3 will require bracing
 - ▶ 1 will require surgery
- ▶ Usually occurs in otherwise apparently healthy children
- ▶ Smaller curves with equal prevalence male:female (1:1.3), but females are 7x more likely to have more progressive curves that require treatment
- ▶ Progresses during rapid growth

Adult-Onset Scoliosis

- ▶ Definition
 - ▶ Degenerative, usually starts later in life
 - ▶ Disc or facet is affected asymmetrically
 - ▶ Usually a primary lumbar curve
 - ▶ Not to be confused with AIS that a patient has in adulthood
- ▶ Prevalence numbers are very variable from 2.5-68% (SRS.org)

Functional Scoliosis

- ▶ Lateral curve that is >10 deg WITHOUT rotation
- ▶ Curve will disappear with forward bend test
- ▶ Examples:
 - ▶ Pelvis obliquity
 - ▶ Leg length discrepancy
 - ▶ Muscular imbalance
 - ▶ Iatrogenic
 - ▶ Degeneration





Pathomechanism and ▶ Treatment for Scoliosis

Theories for development of ALS (Dickson 1984)

- ▶ ~~Muscular imbalance~~
- ▶ ~~Neurological theories~~
- ▶ ~~Connective tissue~~
- ▶ Genetics
 - ▶ Demonstrated familial component
 - ▶ Genetic markers, but multifactorial

Theories for development of AIS (Perdriolle)

- ▶ Uneven growth of the vertebrae in multiple planes is the first event
 - ▶ Transverse Plane - Intra and Inter-vertebral torsion
 - ▶ Sagittal Plane - AP wedging (Relative Anterior Spinal Overgrowth)
 - ▶ Frontal Plane - Lateral wedging
- ▶ Initiating factors
 - ▶ Asymmetrical growth due to failure of the nervous system to control the asymmetries

Theories for development of AIS (Perdriolle 1987)

- ▶ Transverse Plane
 - ▶ Mechanical torsion - structural torsion of the vertebrae and disc
 - ▶ Intra-vertebral at the apex of the curve
 - ▶ Intervertebral at the transitional zones
 - **Pain
- ▶ Geometrical torsion - twisting with translation of the spine in space



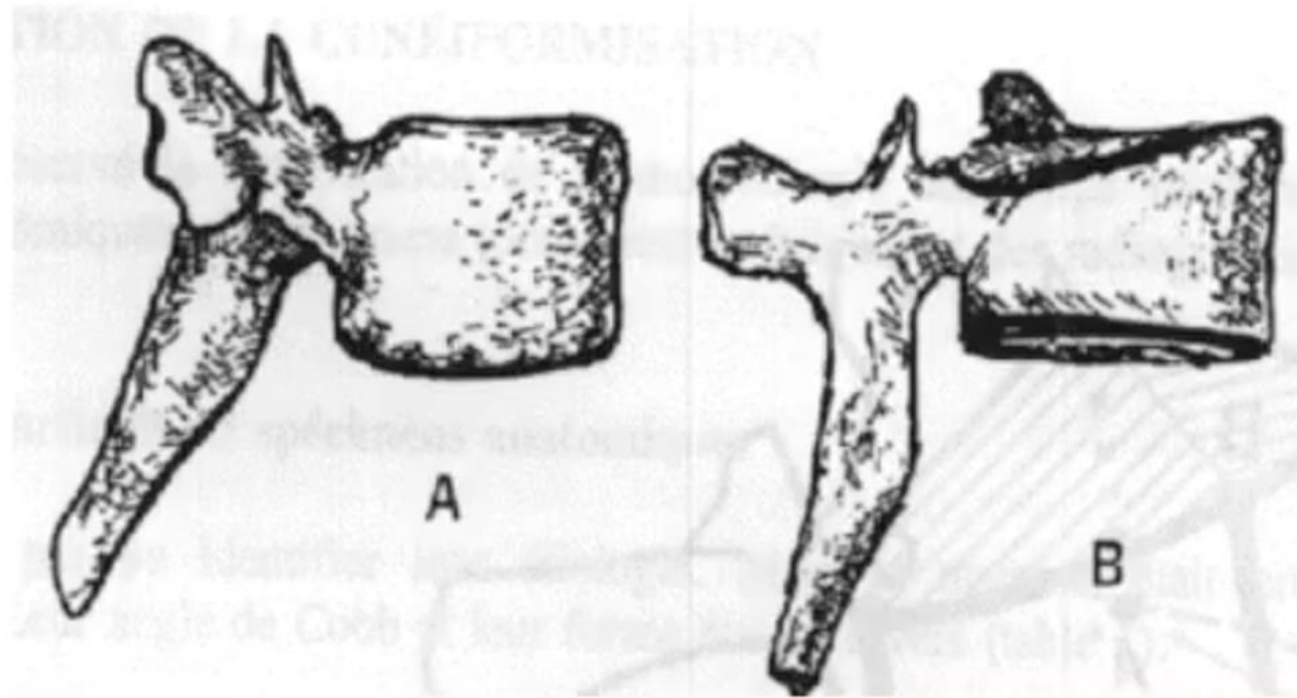
Theories for development of AIS (Perdriolle 1987)

- ▶ Sagittal Plane
 - ▶ Relative Anterior Spinal Overgrowth (RASO)
 - ▶ Leads to a hypokyphosis



Theories for development of AIS (Perdriolle 1987)

- ▶ Frontal Plane
 - ▶ Convex side border is higher than collapsed side



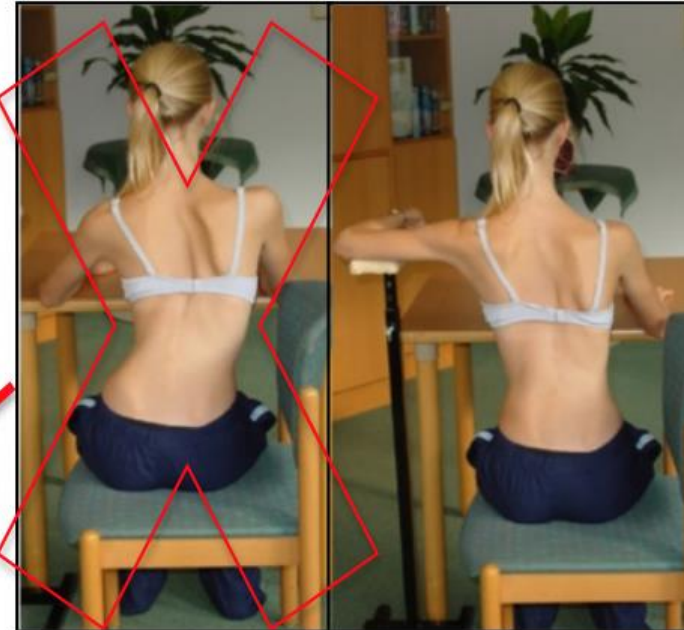
Triggering event

Wedging of
vertebrae

Spinal
Curvature

Asymmetric
growth

Asymmetric
loading



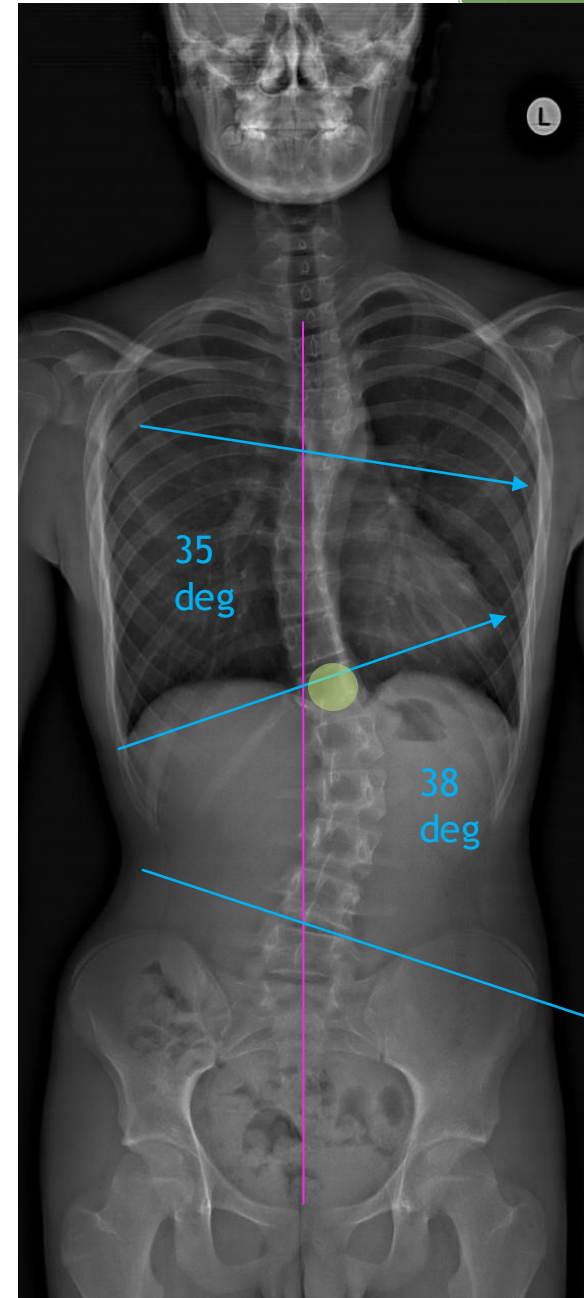
Different Schools of Physiotherapy Scoliosis Specific Exercises (PSSE)

1. SPAIN - Barcelona Scoliosis Physical Therapy School
2. GERMANY - Schroth Asklepios
3. ITALY - Scientific Exercise Approach to Scoliosis - SEAS
4. POLAND - Dobomed and Functional Individual Therapy of Scoliosis - FITS
5. UK - Side Shift
6. FRANCE - The Lyon Method



Treatment for Adolescent Idiopathic Scoliosis

- ▶ Individualized depending on the age (potential for more growth), curve severity, patient's preference
- ▶ Curve Severity is determined by the Cobb angle.
- ▶ **Cobb Angle**
 - ▶ Measured from Upper End Vertebrae to Lower End Vertebrae
 - ▶ UEV and LEV can overlap
 - ▶ +/- 5 deg error
- ▶ **Transition Point**
 - ▶ Used to determine the primary curve and can guide treatment



Treatment for Adolescent Idiopathic Scoliosis

- ▶ <25 deg Cobb Angle
 - ▶ Minimum treatment: Modified PSSE
 - ▶ Maximum treatment: Bracing
- ▶ >25 deg Cobb angle
 - ▶ Minimum treatment: PSSE
 - ▶ Maximum treatment: Bracing
- ▶ 46-50 deg Cobb angle
 - ▶ Minimum treatment: PSSE/brace
 - ▶ Maximum treatment: Surgery
- ▶ Sports and fitness should be encouraged at any stage!



Treatment for Adult Scoliosis

- ▶ Individualized depending on AIS in adulthood versus adult de-novo
- ▶ No pain, any Cobb angle
 - ▶ Observation - fitness
- ▶ Chronic Pain
 - ▶ <30 deg
 - ▶ Minimum treatment: PSSE
 - ▶ Maximum treatment: Bracing
 - ▶ >30 deg
 - ▶ Minimum treatment: Corrective exercises and brace
 - ▶ Maximum treatment: Surgery
- ▶ Sports and fitness participation depends on pain level, degree of curvature
- ▶ Adults may need modifications of their exercise program depending on their curve

Bracing for Scoliosis

- ▶ Bracing is one of the most effective treatments for scoliosis
- ▶ Variety of bracing options available
- ▶ In children and adolescents, there are different bracing protocols
 - ▶ Night bracing
 - ▶ 16- 22 hour bracing
- ▶ More time spent in the brace usually equates to better outcome, especially in periods of rapid growth
- ▶ Compliance can be an issue

Bracing in Adults with Scoliosis

- ▶ For adults, bracing may be used as a support for pain or instability and can be worn as needed
- ▶ Protocols have not been established although new research is emerging
- ▶ Posture supports and posture correcting bras may not be appropriate for clients with scoliosis as it pulls them into a more hypokyphotic or flat back position.





▶ Assessing Clients

Determine Functional vs. Structural Scoliosis

- Look at the Adam's forward bend test



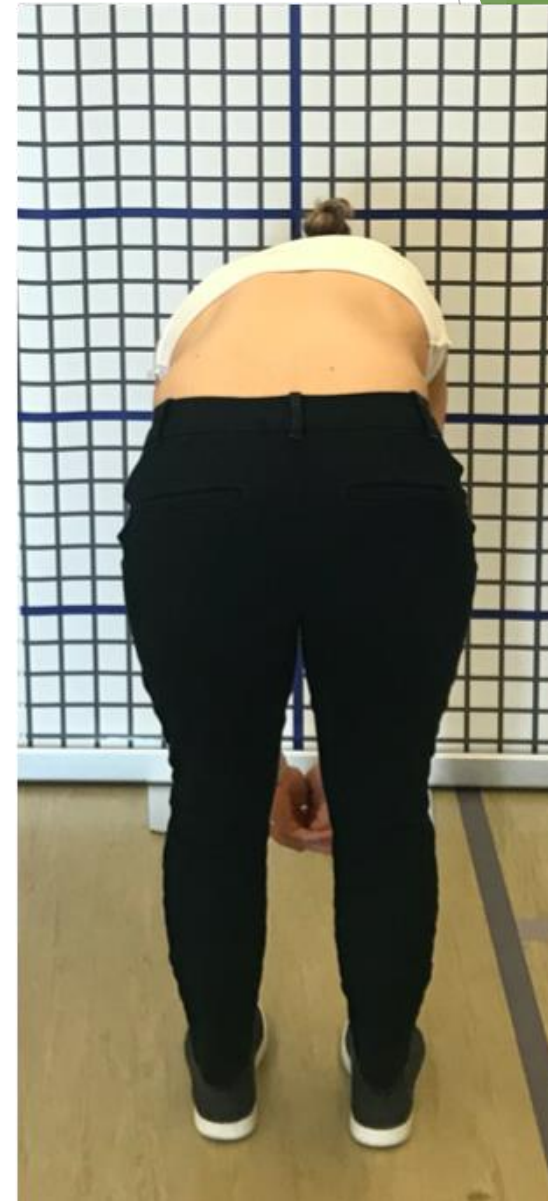
Scoliometer



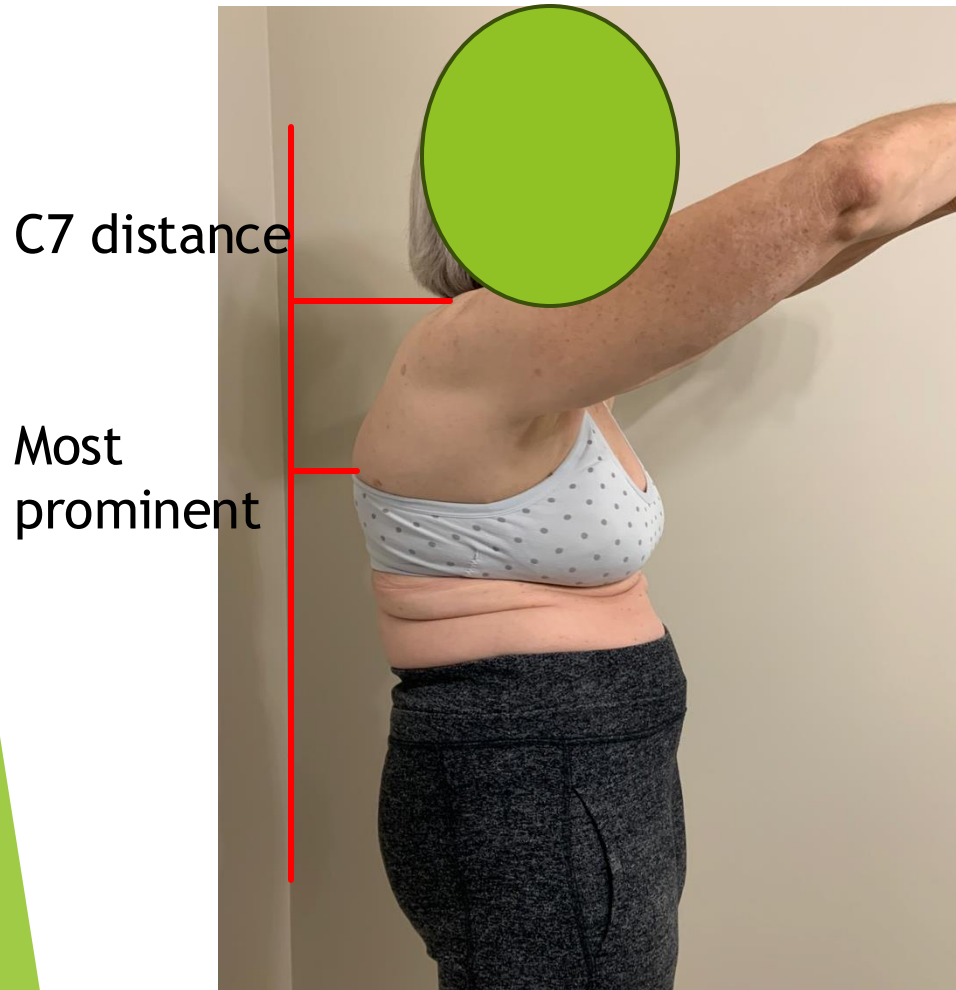
Normal



Abnormal



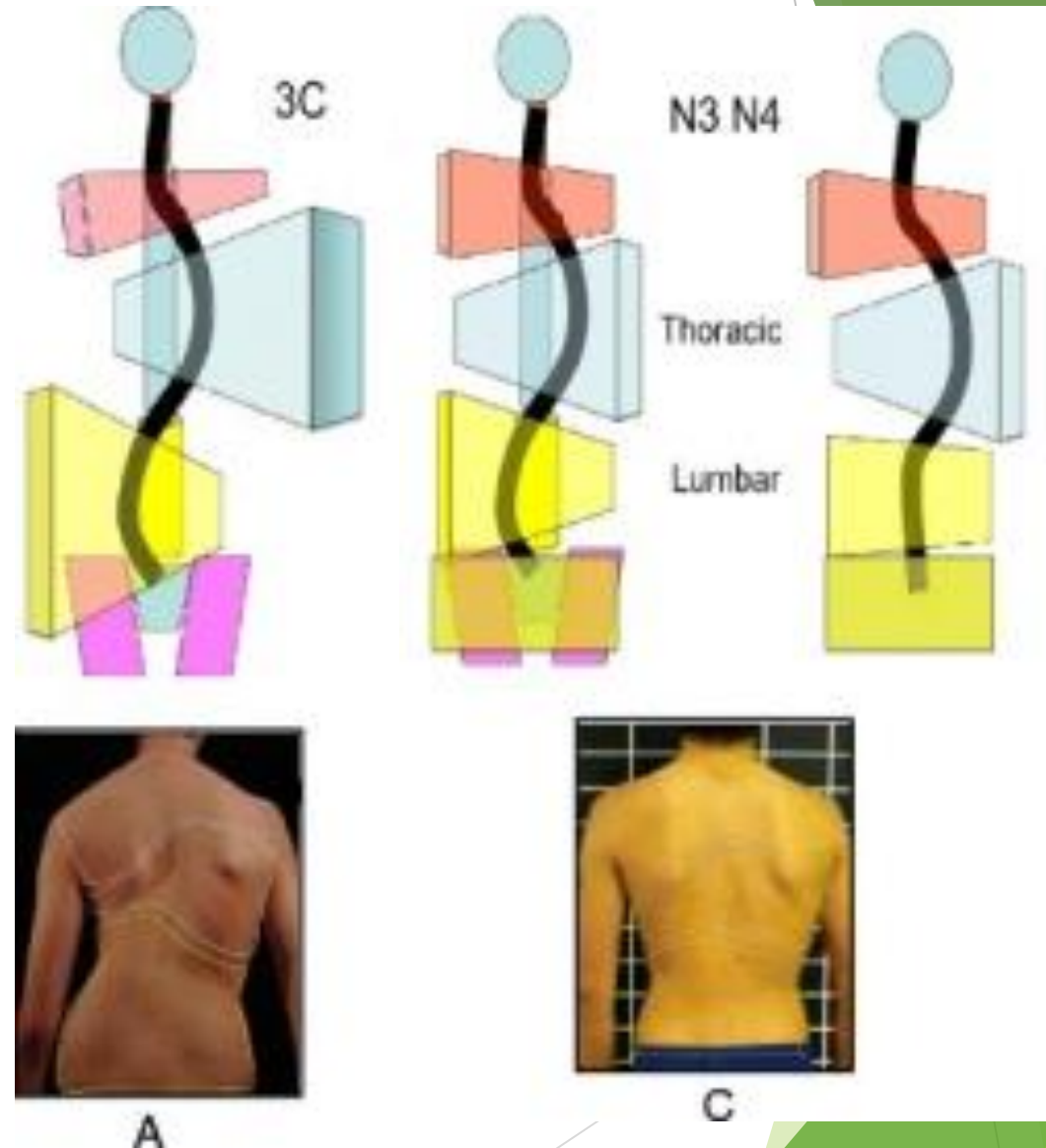
Look at postural in sagittal and frontal profiles



Determine Primary Curve

Thoracic Primary

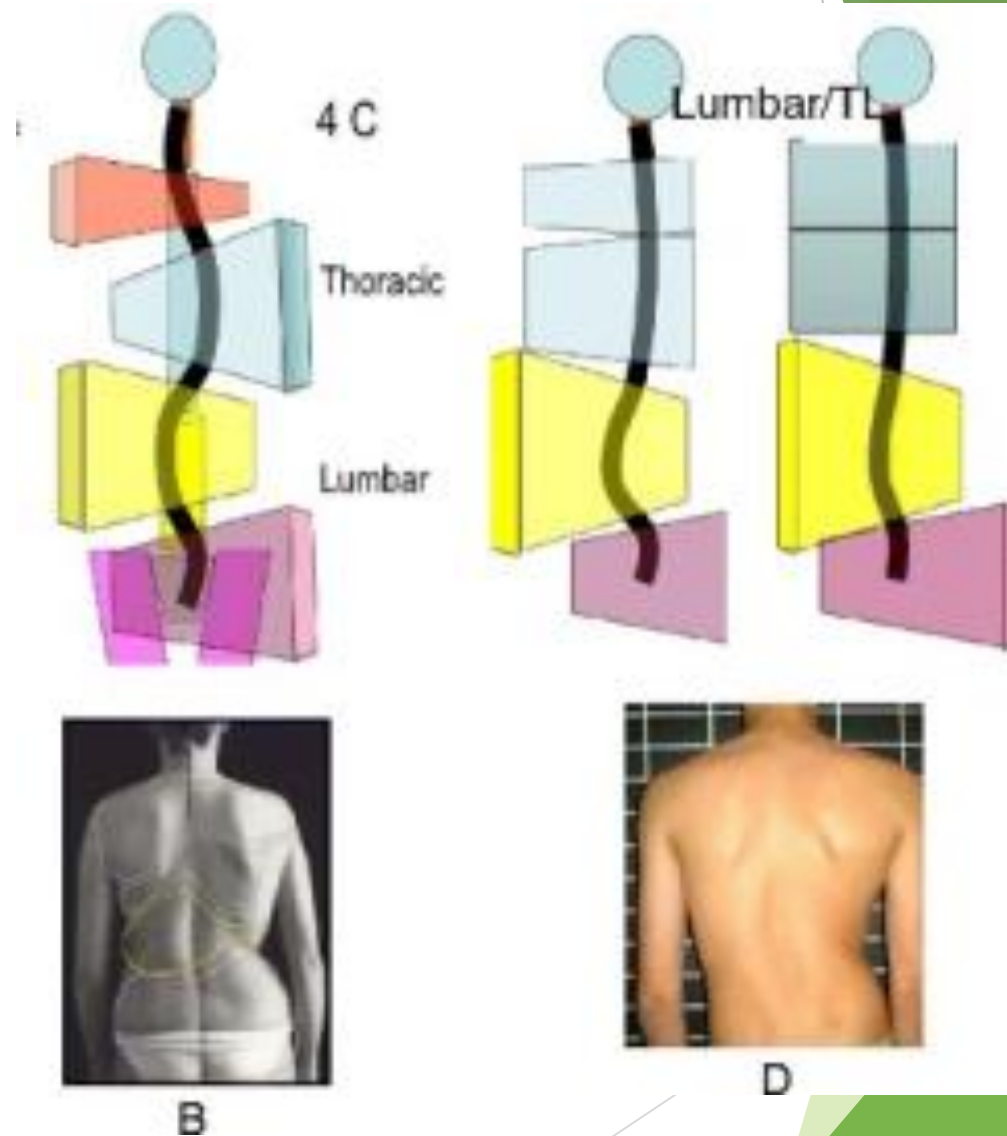
- Thoracic prominence noted in forward bend test
- Lumbar prominence may/may not be noted
- Pelvis is shifted away from the side of the thoracic prominence



Determine Primary Curve

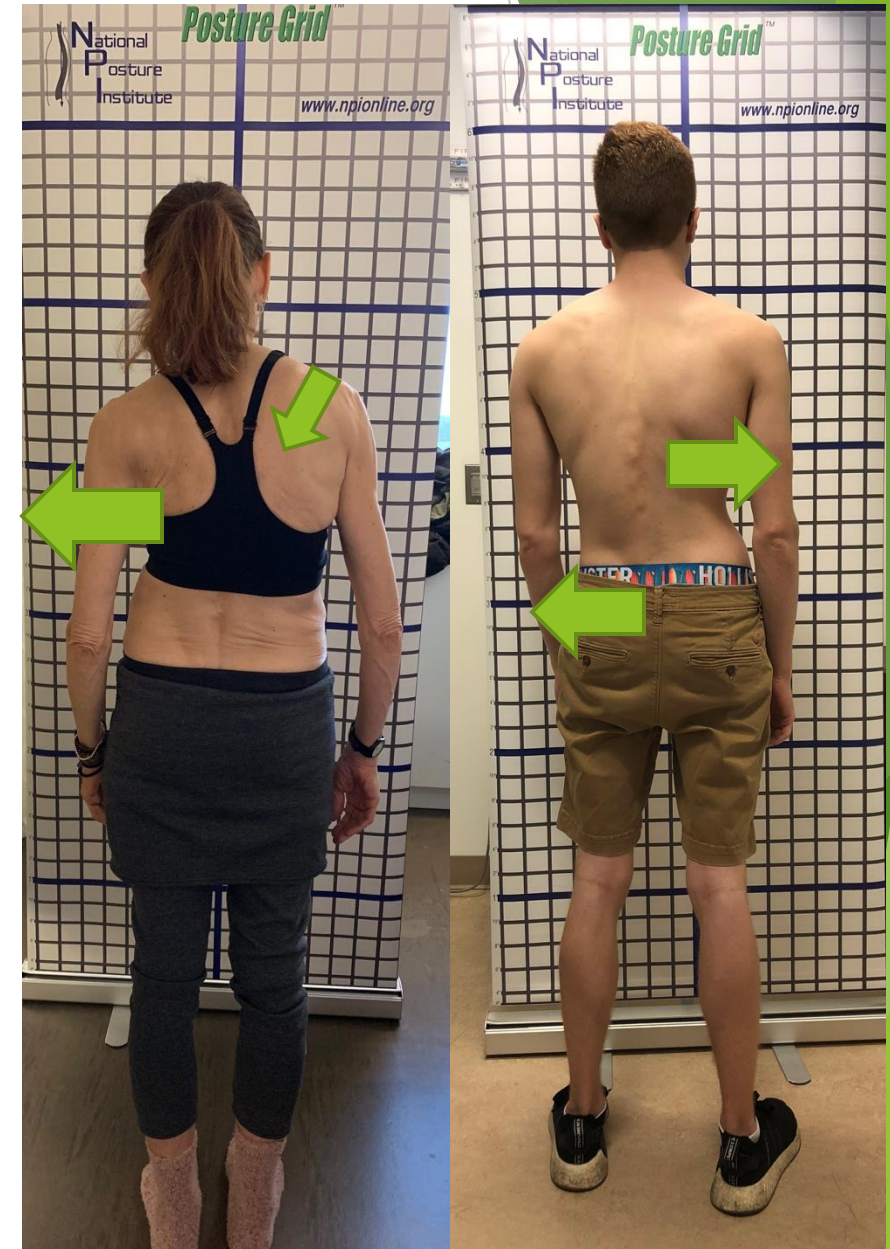
Lumbar Primary

- Thoracic prominence may or may not be noted in forward bend test
- Lumbar prominence is present
- Pelvis is shifted away from the side of the lumbar prominence



Training based on curve type

- ▶ For all curve types:
 - ▶ Focus on breathing and bracing
 - ▶ Focus on elongation of the spine to expand concavities
 - ▶ Work on alignment to neutral first
 - ▶ “Lining up the blocks”
- ▶ For thoracic primary:
 - ▶ Special attention to the thoracic collapsed area and the position of the scapula over the prominence
- ▶ For lumbar primary:
 - ▶ Special attention to lumbar collapsed area and the relationship of the lumbar spine and the pelvis





► Fitness and Scoliosis

Pilates and Scoliosis

Effects of Schroth and Pilates exercises on the Cobb angle and weight distribution of patients with scoliosis

GICHUL KIM, PhD, PT¹⁾, PIL-NEO HWANGBo, PhD, PT²⁾*

- ▶ 24 female students (average age 15 years old) with scoliosis performed either Schroth exercises or pilates exercises 3 times per week over a 3 week period
- ▶ Both pilates and Schroth exercises improved Cobb angle, however, the Schroth group's performance was significantly higher than the pilates group
- ▶ Only the Schroth group had improvements in standing weight distribution
- ▶ Pilates can help to reduce Cobb angle, but not as much as Schroth exercises

Serial Case Reporting Yoga for Idiopathic and Degenerative Scoliosis

系列案例报告瑜伽治疗特发性和退行性脊柱侧弯

Informe de serie de casos sobre el yoga para la escoliosis idiopática y degenerativa

Loren M. Fishman, MD, *United States*; Erik J. Groessl, PhD, *United States*; Karen J. Sherman, PhD, MPH, *United States*

Yoga and Scoliosis

- ▶ Included 25 patients ages 14-85 years old
- ▶ Used a modification of Iyengar sideplank with the thoracic convex side down, patients were educated to elevate their ribs
- ▶ Participants were instructed to perform for 20 seconds daily for one week, then perform once daily for as long as possible after
- ▶ Follow up was variable, between 3-22 months
- ▶ Significant curve improvements noted - 32% on average
- ▶ Limitations: small group size, large range of results (0-72% correction in adolescents)



Figure 1 The classical Iyengar side plank pose with the addition of the ribs raised vertically.

Stretching

Acute muscle stretching and the ability to maintain posture in females with adolescent idiopathic scoliosis

- ▶ Eighteen females with AIS average age 13 years old
- ▶ Experimental group performed a series of static back and neck stretching exercises (child's pose, modified slump, standing forward bend, plow) before doing their postural correction
- ▶ Stretching before had a negative affect on the ability to maintain postural alignment
- ▶ This aligns with some other studies that stretching right before exercise may be detrimental to performance, but we cannot make sweeping conclusions about stretching for clients with scoliosis
- ▶ Limitations:
 - ▶ All stretches were focused on lumbar flexion
 - ▶ Stretching was performed only 2x and immediately before the exercise

To modify or not?

- ▶ We know that scoliosis development is related to wedging and changes in the vertebrae
- ▶ Therefore, should we change exercises based on these deformities?
- ▶ If clients have pain, what should we do?



Adolescent Idiopathic Scoliosis

- ▶ Adolescents with scoliosis should participate in a weightbearing exercise program as there is a link of scoliosis progression and decreased bone mass
- ▶ Focus on coordination, strengthening, and control in a corrected posture
- ▶ Sports with extreme flexibility requirements may be supplemented by additional stability training
- ▶ Adolescents may or not have pain
 - ▶ With pain should be referred to Schroth physical therapy
 - ▶ No pain, referral will depend on curve severity and whether the child is still growing

Sports are NOT a treatment for scoliosis

- ▶ Sports can help with:
 - ▶ Muscular strength
 - ▶ Flexibility
 - ▶ Balance
 - ▶ Coordination
 - ▶ Cardiovascular fitness
- ▶ However, sports are not a treatment for scoliosis
- ▶ In fact, some sports focused on increasing flexibility may increase scoliosis progression (ex: rhythmic gymnastics)

Risk of Spinal Deformity in Sport

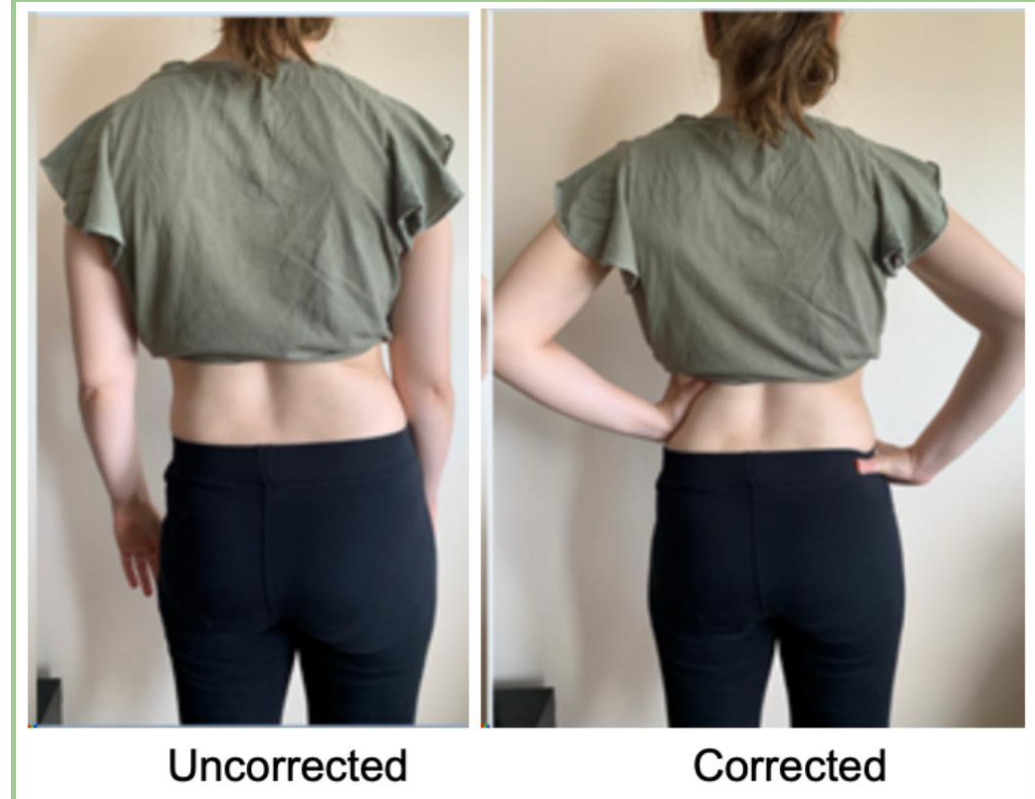
Sport	Study	Result
Tennis	Zaina, et al 2016	No correlation between tennis and spinal asymmetries No correlation between tennis and low back pain incidence
Ballet	Longworth, et al 2014	Dancers 12x more likely to have scoliosis than non-dancers Likely related to physical traits of those who choose to dance: hypermobility, low BMI, delayed menarche; that are also related to scoliosis diagnosis
Swimming	Zaina, et al 2015	Higher risk of trunk asymmetries, especially in females
Rhythmic Gymnastics	Tanchev, et al 2000	Rhythmic gymnasts 10x more likely to have scoliosis - related to general joint laxity, asymmetric loading, delayed menarche
Volleyball	Grabara, et al 2015	Some asymmetries associated with lateralization in both the volleyball and control group

Sports and Bracing (Green et al, 2009)

- ▶ Brace and surgically treated clients with scoliosis can perform in sports activities at the same levels as controls
- ▶ Brace and observation-only treated clients are encouraged to participate in physical activity
- ▶ Non-surgically treated scoliosis is not a contraindication for sports participation
- ▶ Brace-treated clients can perform sports with or without their braces on
- ▶ Sports and exercise may be restarted months after scoliosis correction surgery (6 months-1 year depending on the surgeon and type of sport)
 - ▶ Non-contact sports at 6 months
 - ▶ Contact sports at 1 year
 - ▶ Collision sports may be prohibited or 1 year, depends on surgeon

Adult degenerative scoliosis

- ▶ With adult degenerative scoliosis, pain is more of a factor
- ▶ Clients will often complain of pain at transition points of their curve (ex: fractional lumbosacral curve)
- ▶ There is risk of lateral listhesis, therefore, exercises that increase rotation should be avoided
- ▶ If there is pain, they should be referred to a physical therapist with specific training in PSSE
- ▶ If there is no pain, they should still be monitored for alignment throughout exercises
 - ▶ Focus on active correction of sagittal plane first, then frontal plane
 - ▶ Maintain neutral alignment as much as possible
 - ▶ Avoid exercises that increase spinal collapse



Fitness Algorithm for Adult Scoliosis

Clinical Adult Spine Modifiers
When No X-ray Available



Coronal Imbalance
Grunstein Spine Deform. 2013

Thoraco-Lumbar curve



Scoliometer
Cote Spine. 1998

Single TL/Lumbar curve

T1 Plumb line ≥ 7.5 cm

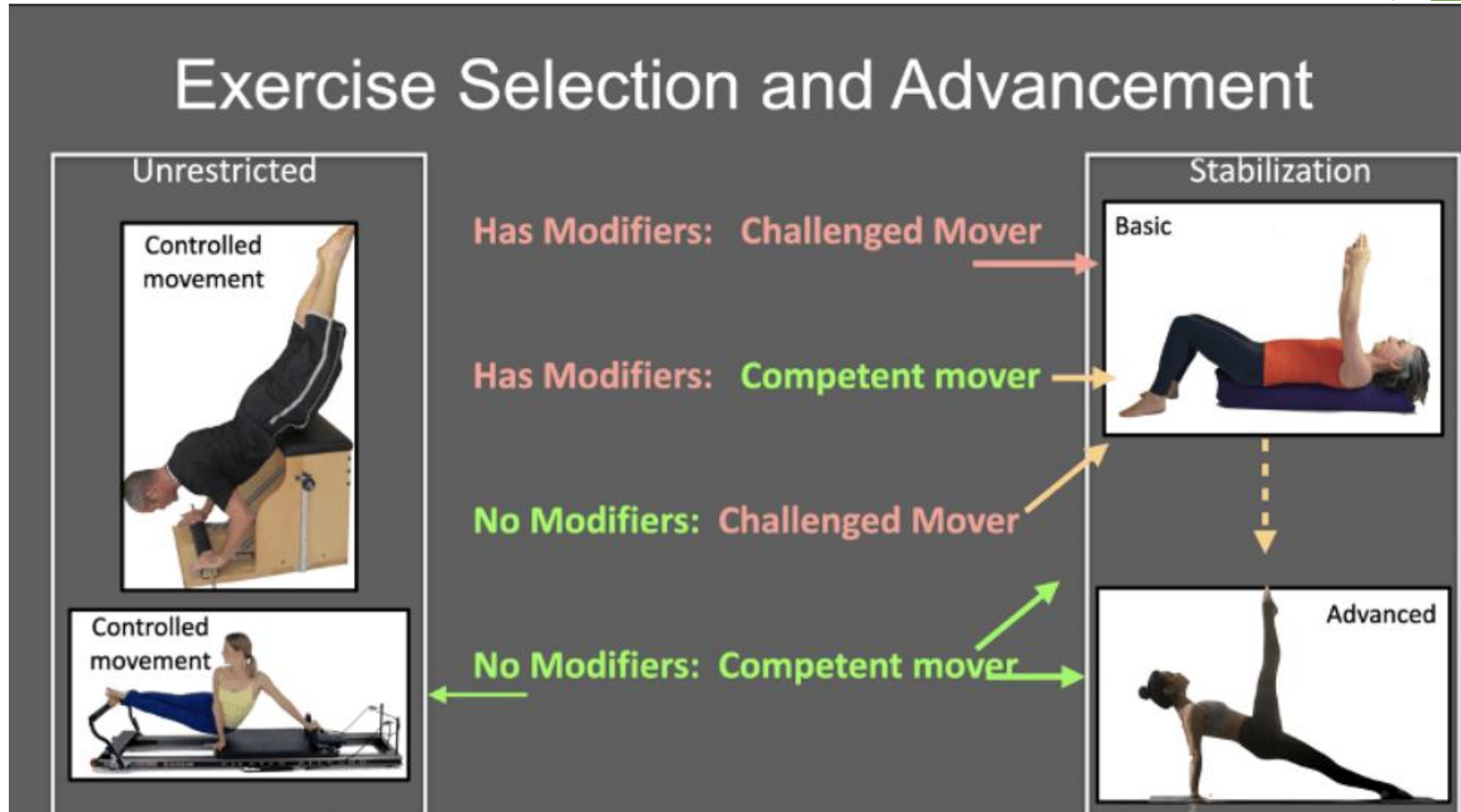
Coronal Imbalance ≥ 3 cm



C7 to Wall Distance
Suwannarat P Archives of Osteoporosis 2018

<https://polestarpilates.com/fitness-guidelines-for-adults-with-spinal-disorders/>

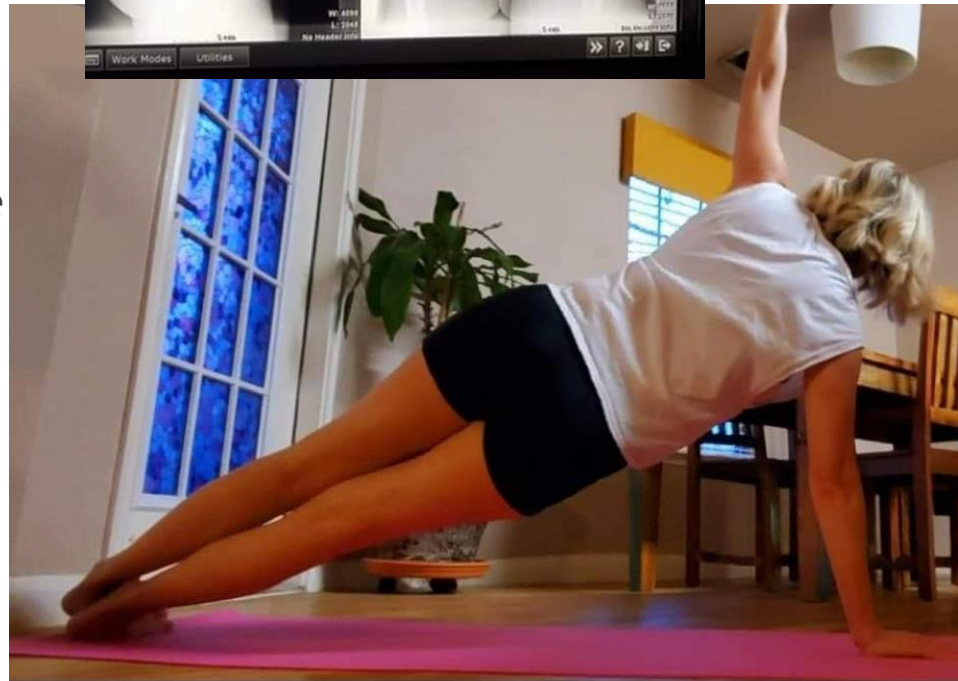
Fitness Algorithm for Adult Scoliosis

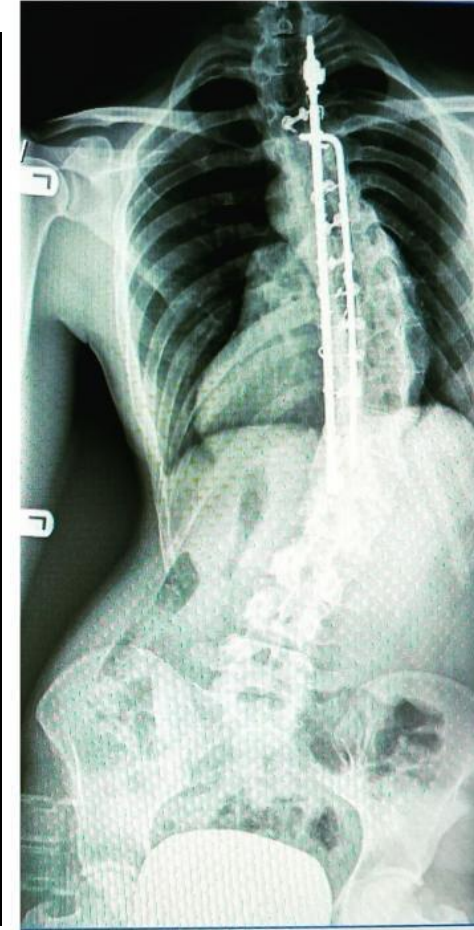


<https://polestarpilates.com/fitness-guidelines-for-adults-with-spinal-disorders/>

Adolescents and Adults with Fusion

- ▶ Important to have a discussion with the client, their surgeon, and/or physical therapist
- ▶ Depending on the levels of the fusion will change what the client is permitted to do
 - ▶ Selective thoracic fusion may have more ability to return to sports and fitness sooner, but will be limited in mobility of the upper back
 - ▶ Long fusions (Upper thoracic to pelvis) and any fusion that involves the pelvis may not be allowed to perform deep squats or bending for risk of hardware failure
- ▶ Important to emphasize trunk stability and hip hinging mechanics





Adolescents and
Adults with Fusion



► Fitness Ideas

Where to start...

- ▶ All types of exercise are encouraged for scoliosis, however, strength and stability training are especially important to help stabilize the muscles around the curve
- ▶ It is not necessary to only train one side or the other - both sides can be trained equally unless there is a large discrepancy in strength noted
- ▶ Posture, alignment, and stability are key
- ▶ Visual, tactile, and verbal cueing can be helpful to teach the client to maintain their best neutral alignment.
 - ▶ "Elongate your spine"
 - ▶ "Be as tall as you can"
 - ▶ "Line up your blocks"

Elongation Stretches



Seated Reach

- Inhale, push the pelvis down into the chair and arms up higher without shrugging the shoulders
- Exhale, keep the spine long and try to keep the alignment made by the inhale



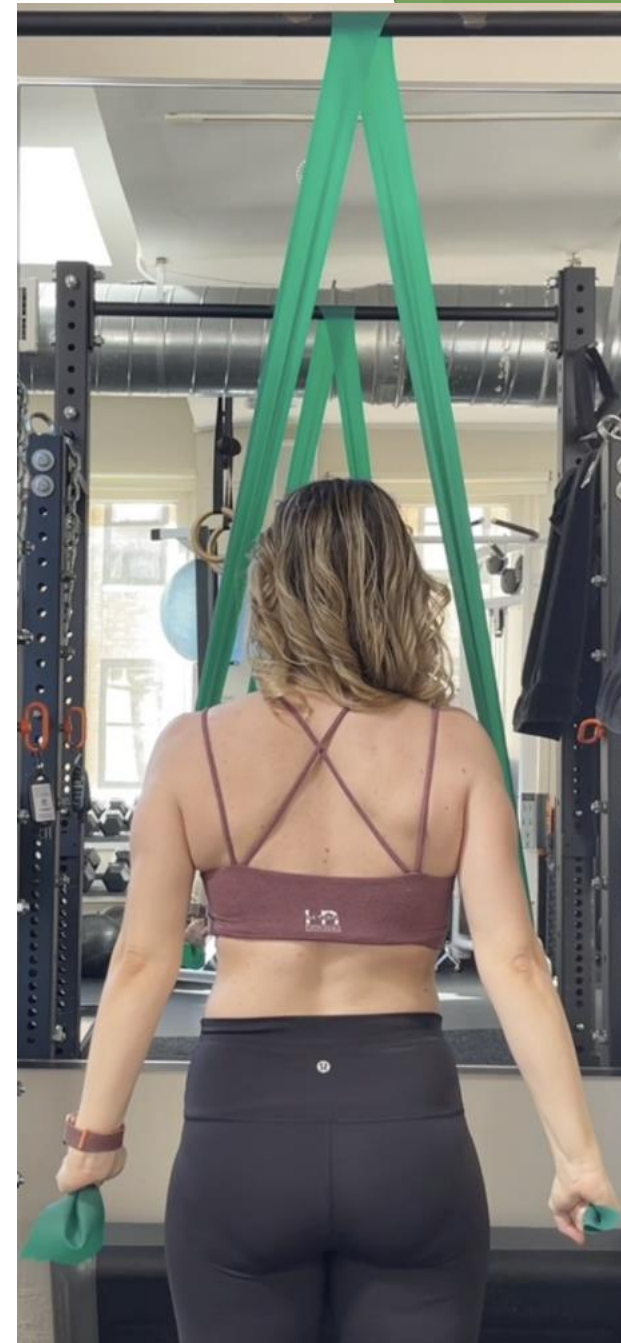
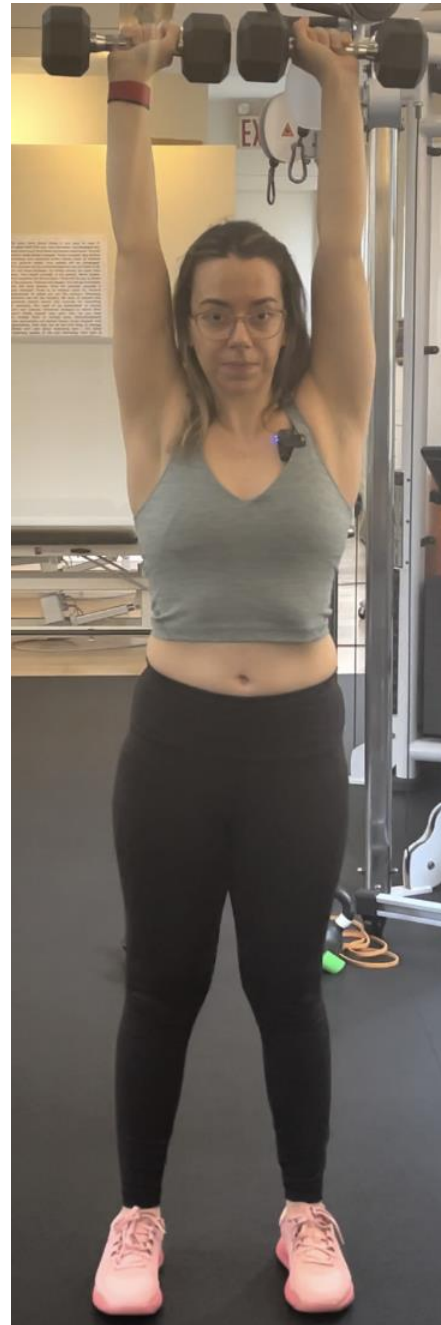
Quadruped Rockback

- Inhale to lengthen
- Sit your hips to your heels without rounding your back
- Maintain your length as you exhale
- Reset to quadruped and practice again

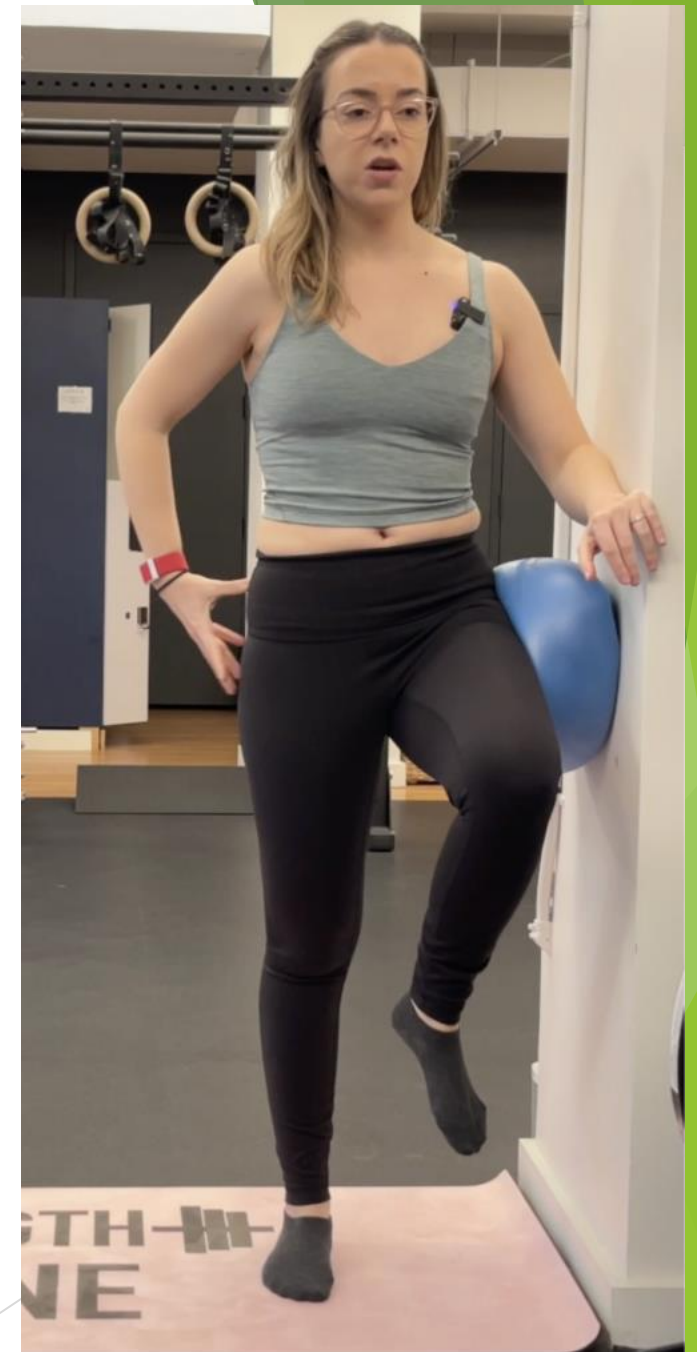
Trunk Strengthening Ideas



Upper Body Strengthening Ideas



Lower Body Strengthening Ideas



Client Example



Client Example



Take Away

- ▶ Adolescent Idiopathic Scoliosis is a 3D structural condition that develops because of abnormal growth of the vertebrae
- ▶ Sports and fitness are safe for most clients with scoliosis, but should not be the only treatment
- ▶ Exercises that emphasize end range rotation, flexion, or extension of the spine may not be beneficial, especially in growing athletes with scoliosis and adult degenerative scoliosis, but we must consider the client as a whole
- ▶ Adults with degenerative scoliosis need more focus on sagittal alignment than frontal
- ▶ Fitness programs can be tailored depending on the primary curve
- ▶ Fitness programs for scoliosis should focus on active postural corrections and stability training

Where to Learn More!

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- ▶ drbeth@strengthandspine.com
- ▶ www.strengthandspine.com
- ▶ [@strengthandspine](https://www.instagram.com/strengthandspine)

- ▶ <https://www.scoliosisandspineonlinelearning.com>
- ▶ <https://www.srs.org>
- ▶ <https://www.sosort.org>

References

- ▶ Alves de Araújo, M. E., Bezerra da Silva, E., Bragade Mello, D., Cader, S. A., Shiguemi Inoue Salgado, A., & Dantas, E. H. M. (2012). The effectiveness of the Pilates method: Reducing the degree of non-structural scoliosis, and improving flexibility and pain in female college students. *Journal of Bodywork and Movement Therapies*, 16(2), 191-198.
<https://doi.org/10.1016/j.jbmt.2011.04.002>
- ▶ Diarbakerli, E., Grauers, A., Danielsson, A., & Gerdhem, P. (2017). Adults With Idiopathic Scoliosis Diagnosed at Youth Experience Similar Physical Activity and Fracture Rate as Controls: *SPINE*, 42(7), E404-E410.
<https://doi.org/10.1097/BRS.0000000000001841>
- ▶ Fishman, L. M., Groessl, E. J., & Sherman, K. J. (2014). Serial Case Reporting Yoga for Idiopathic and Degenerative Scoliosis. *Global Advances in Health and Medicine*, 3(5), 16-21. <https://doi.org/10.7453/gahmj.2013.064>
- ▶ Green, B. N., Johnson, C., & Moreau, W. (2009a). Is physical activity contraindicated for individuals with scoliosis? A systematic literature review. *Journal of Chiropractic Medicine*, 8(1), 25-37.
<https://doi.org/10.1016/j.jcm.2008.11.001>
- ▶ Green, B. N., Johnson, C., & Moreau, W. (2009b). Is physical activity contraindicated for individuals with scoliosis? A systematic literature review. *Journal of Chiropractic Medicine*, 8(1), 25-37.
<https://doi.org/10.1016/j.jcm.2008.11.001>
- ▶ Kenanidis, E. I., Potoupnis, M. E., Papavasiliou, K. A., Sayegh, F. E., & Kapetanios, G. A. (2010). Adolescent Idiopathic Scoliosis in Athletes: Is There a Connection? *The Physician and Sportsmedicine*, 38(2), 165-170.
<https://doi.org/10.3810/psm.2010.06.1795>
- ▶ Kenanidis, E., Potoupnis, M. E., Papavasiliou, K. A., Sayegh, F. E., & Kapetanios, G. A. (2008). Adolescent Idiopathic Scoliosis and Exercising: Is There Truly a Liaison? *Spine*, 33(20), 2160-2165.
<https://doi.org/10.1097/BRS.0b013e31817d6db3>

References

- ▶ Kim, G., & HwangBo, P. (2016). Effects of Schroth and Pilates exercises on the Cobb angle and weight distribution of patients with scoliosis. *Journal of Physical Therapy Science*, 28(3), 1012-1015. <https://doi.org/10.1589/jpts.28.1012>
- ▶ Levi, D., Springer, S., Parmet, Y., Ovadia, D., & Ben-Sira, D. (2019). Acute muscle stretching and the ability to maintain posture in females with adolescent idiopathic scoliosis. *Journal of Back and Musculoskeletal Rehabilitation*, 32(4), 655-662. <https://doi.org/10.3233/BMR-181175>
- ▶ Longworth, B., Fary, R., & Hopper, D. (2014). Prevalence and Predictors of Adolescent Idiopathic Scoliosis in Adolescent Ballet Dancers. *Archives of Physical Medicine and Rehabilitation*, 95(9), 1725-1730. <https://doi.org/10.1016/j.apmr.2014.02.027>
- ▶ Negrini, S., Fusco, C., Minozzi, S., Atanasio, S., Zaina, F., & Romano, M. (2008). Exercises reduce the progression rate of adolescent idiopathic scoliosis: Results of a comprehensive systematic review of the literature. *Disability and Rehabilitation*, 30(10), 772-785. <https://doi.org/10.1080/09638280801889568>
- ▶ Negrini, Stefano, Donzelli, S., Negrini, F., Romano, M., & Zaina, F. (n.d.). *Bracing does not change the sport habits of patients*. 5.
- ▶ Parsch, D., Gärtner, V., Brocai, D. R. C., Carstens, C., & Schmitt, H. (2002). Sports Activity of Patients With Idiopathic Scoliosis at Long-Term Follow-Up: *Clinical Journal of Sport Medicine*, 12(2), 95-98. <https://doi.org/10.1097/00042752-200203000-00005>
- ▶ Picelli, A., Negrini, S., Zenorini, A., Iosa, M., Paolucci, S., & Smania, N. (2016). Do adolescents with idiopathic scoliosis have body schema disorders? A cross-sectional study. *Journal of Back and Musculoskeletal Rehabilitation*, 29(1), 89-96. <https://doi.org/10.3233/BMR-150602>
- ▶ Šarčević, Z., & Tepavčević, A. (2019). Association between adolescent idiopathic scoliosis and sacroiliac joint dysfunction in young athletes: A case control study. *Medicine*, 98(15), e15161. <https://doi.org/10.1097/MD.00000000000015161>

References

- ▶ Segreto, F. A., Messina, J. C., Doran, J. P., Walker, S. E., Aylyarov, A., Shah, N. V., Mixa, P. J., Ahmed, N., Paltoo, K., Opore-Sem, K., Kaur, H., Day, L. M., Naziri, Q., Paulino, C. B., Scott, C. B., Hesham, K., Urban, W. P., & Diebo, B. G. (2019). Noncontact sports participation in adolescent idiopathic scoliosis: Effects on parent-reported and patient-reported outcomes. *Journal of Pediatric Orthopaedics B*, 28(4), 356-361. <https://doi.org/10.1097/BPB.0000000000000574>
- ▶ Tanchev, P. I., Dzherov, A. D., Parushev, A. D., Dikov, D. M., & Todorov, M. B. (2000). Scoliosis in Rhythmic Gymnasts: *Spine*, 25(11), 1367-1372. <https://doi.org/10.1097/00007632-200006010-00008>
- ▶ Tojima, M., Osada, A., & Torii, S. (2019). Changes in thoracic and lumbar spinal motions during running in a female with scoliosis. *Journal of Physical Therapy Science*, 31(10), 855-859. <https://doi.org/10.1589/jpts.31.855>
- ▶ Vitale, M. A., Choe, J. C., Sesko, A. M., Hyman, J. E., Lee, F. Y., Roye, D. P., & Vitale, M. G. (2006). The effect of limb length discrepancy on health-related quality of life: Is the '2 cm rule' appropriate?: *Journal of Pediatric Orthopaedics B*, 15(1), 1-5. <https://doi.org/10.1097/01202412-200601000-00001>
- ▶ Zaina, F., Donzelli, S., Lusini, M., Fusco, C., Minnella, S., & Negrini, S. (2016). Tennis is not dangerous for the spine during growth: Results of a cross-sectional study. *European Spine Journal*, 25(9), 2938-2944. <https://doi.org/10.1007/s00586-016-4452-1>
- ▶ Zaina, F., Donzelli, S., Lusini, M., Minnella, S., & Negrini, S. (2015). Swimming and Spinal Deformities: A Cross-Sectional Study. *The Journal of Pediatrics*, 166(1), 163-167. <https://doi.org/10.1016/j.jpeds.2014.09.024>