An overview of Scoliosis and its causes, as well as current treatment options

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ABSTRACT

Scoliosis is defined as a deviation from the spine's normal vertical line, characterized by a lateral curvature with vertebral rotation inside the curve. The posterior-anterior radiograph should demonstrate at least 10° of spinal angulation with vertebral rotation to be considered for scoliosis. Scoliosis is the most common spinal condition in children and adolescents. Scoliosis is described as a side-to-side curvature of the spine greater than 10°, frequently in conjunction with vertebral rotation and, in most cases, a reduced kyphosis in thoracic curves. Scoliosis is a spine malformation that often appears in the first two decades of life. Scoliosis is most commonly seen as a back deformity, although it can also be discovered by chance on a radiograph or be associated with a complaint of discomfort or an unrelated condition. To varied degrees, the curve is accompanied with trunk imbalance and an unequal rib prominence or "rib hump." It is a growing child phenomena that appears during growth, deteriorates with growth rate, and stabilizes near the end of growth. In a scoliosis therapy regimen, patients receive individually tailored exercises. Patients are taught an exercise routine that is customized to their medical and physiotherapeutic requirements. In contrast, typical generalist physiotherapy is more generic, consisting of low-impact stretching and strengthening activities such as yoga, but can span a wide range of exercise routines.

Keyword: Scoliosis, Classifications, Pathophysiology, Treatments, Psychosocial, Quality of Life (QoL)
INTRODUCTION

Scoliosis is derived from the ancient Greek word skolios, which means "curve." It is defined as a lateral spine curvature larger than 10, as measured by the Cobb angle on posteroanterior (PA) radiographs (1). Scoliosis was initially mentioned by Hippocrates, who remarked, "There are numerous forms of curvature of the spine even in those who are in excellent condition, for it takes place from natural conformation and from habit, and the spine is liable to be bent from old age and from aches" (2). Scoliosis is described as a deviation from the normal vertical line of the spine, characterized by a lateral curvature with vertebral rotation inside the curve. To be considered for scoliosis, the posterior-anterior radiograph should show at least 10° of spinal angulation accompanied with vertebral rotation (3). Scoliosis is the most prevalent spinal disease in children and teenagers. Scoliosis is defined by a side-to-side curvature of the spine>10°, which is usually combined with vertebral rotation and, in most cases, a reduced kyphosis in thoracic curves (4). Scoliosis is a spine deformity that usually shows itself during the first two decades of life (5). Scoliosis causes vary and are broadly classed as congenital, neuromuscular, syndrome-related, idiopathic, and spinal curvature due to secondary causes. Congenital scoliosis is caused by a vertebral defect, which causes a mechanical deviation from normal spinal alignment. Scoliosis can be caused by neurological disorders (for example, cerebral palsy or paralysis), muscular abnormalities (for example, Duchenne muscular dystrophy), or other syndromes (for example, Marfan syndrome and neurofibromatosis). Significant lateral deviation of the spine can occur with little or no rotation of the spine and without bone deformities on rare occasions (6). Scoliosis usually manifests as a back deformity, although it can also appear as a random discovery on a radiograph or be connected with a complaint of discomfort or an unrelated ailment. The curve is accompanied, to varying degrees, by trunk imbalance and an uneven rib prominence or"rib hump." It is a phenomenon of growing children that appears during growth, deteriorates with growth rate, and stabilizes towards the conclusion of growth (7). Scoliosis is a three-dimensional abnormality of the spine. Congenital abnormalities and neuromuscular illness are two of the most often recognized reasons. However, idiopathic scoliosis is diagnosed in children who have no obvious physical indications of concomitant disease and who do not have a detectable anatomical precipitant on plain radiographs of the spine (8). Scoliosis patients are divided into distinct categories based on their age of onset, aetiology, severity, and curve shape. Each variety has distinct characteristics such as curve advancement rate, degree, and pattern of three-dimensional deformity. Scoliosis is characterized according to its aetiology: idiopathic, congenital, or neuromuscular. Idiopathic scoliosis is the diagnosis when all other reasons are ruled out, and it accounts for roughly 80% of all instances. The most prevalent kind of scoliosis is adolescent idiopathic scoliosis, which is usually diagnosed during puberty. A high rate of curve advancement and an early beginning of scoliosis are risk factors for a bad result in idiopathic scoliosis, such as thoracic insufficiency syndrome (9). Until date, the prevalence in India has been reported only from two limited geographical regions: Patiala, Punjab, and Assam. The current study is the first to look at scoliosis screening and prevalence in the people of J&K, India. Surprisingly, we found a high frequency of scoliosis in our target location, compared to 0.13% in the population of Patiala, Punjab, and 0.2% in Assam. Similarly, studies have found lower rates of scoliosis in nations such as Japan (0.87%), Saudi Arabia (0.78%), and Singapore (0.27-2.49% among 9-13 year old females) (10).
CLASIFICATIONS OF SCOLIOSIS

Scoliosis is classified into three types: idiopathic, congenital, and neuromuscular (11,12).

In 1954, James in England categorized IS based on the age of onset. Infantile (birth to 3 years), Juvenile (4-9 years), and Adolescent Idiopathic Scoliosis (AIS) (4-10 years old) are the three types. IS is the most frequent type of scoliosis, accounting for about 80% of all cases (13–15). Congenital scoliosis develops as a result of aberrant spinal column growth and development, most likely as a result of intrauterine events during the sixth week of pregnancy. Neuromuscular scoliosis is frequently found in paediatric patients suffering from neurologic and myopathic illnesses such as cerebral palsy. It has an early onset and rapid progression even beyond skeletal maturity. The curves are frequently lengthy, extend into the sacrum, and are related with pelvic obliquity (16–19). IS classification has shifted slightly in recent years. More attention has been placed on pulmonary development in relation to the onset of scoliosis, with a 5-year age threshold being crucial for lung development. Congenital scoliosis is caused by spinal deformities of the spine that are present at birth. These irregularities, which can occur at numerous levels, are caused by a failure of development or a failure of segmentation (or both) during vertebral formation. Because these spinal abnormalities occur in pregnancy, they are frequently detected on embryonic ultrasonography (20). In up to 60% of cases, organ systems that develop at the same gestational time (fifth to sixth week) may also show abnormalities (21,22). As a result, it is critical to discover related anomalies through a complete evaluation of the neurologic, cardiovascular, and genitourinary systems, which includes a thorough neurologic and cardiac physical examination, an abdomen ultrasound, and echocardiography. Treatment is determined by the patient's age, the progression of the curve, and the location and type of anomaly. Surgical treatment options include in situ fusion and excision with deformity correction. Scoliosis can be linked to neurological disorders, muscle anomalies, and worldwide diseases. In addition to scoliosis, this broad list of diagnoses would often include other signs, symptoms, and physical manifestations. These various diagnoses are usually treated at tertiary care facilities that have unique competence in managing patients with severe multisystem diseases. The carer who treats these individuals should be conversant with the illnesses' non-spinal symptoms. As previously stated, a curvature in the coronal plane can be seen on radiographs with limited or no rotation of the vertebral bodies. Pain is frequently related with deformity. This isn't real scoliosis, and other causes of the deformity should be looked at. In some aspects, idiopathic scoliosis is an exclusion diagnosis. Idiopathic scoliosis, on the other hand, is by far the most prevalent type of spinal deformity, with a prevalence of one to three per 100 (curves higher than 10°) in a balanced number of boys and girls (23–26).
CAUSES OF SCOLIOSIS

There is debate about whether scoliosis is simply inherited or has certain contributing elements, such as exercise and environment. According to Zhuang et al., individuals with adolescent idiopathic scoliosis (AIS) displayed an alteration in five bone growth-related proteins, notably pyruvate kinase M2, annexin A2, heat shock 27 k protein, β-actin, and γ-actin (28). Furthermore, linkage analysis revealed that mutations in the MAPK7 gene locus and allel marker DS 1034 on chromosome 19p13.3 lead to AIS (29). A genome-wide association study (GWAS) specifically looked into AIS by analysing single nucleotide polymorphisms (SNPs) and symptoms, as well as copy number variants (CNV). Ogura et al. discovered that ladybird homeobox 1 (LBX1) and CNV of chromosomes 1q21.1, 2q13, 15q11.2, and 16p11.2 harbour AIS (30). Furthermore, Mao et al. investigated DNA methylation levels and discovered an inverse link between cartilage oligomeric matrix protein (COMP) promoter and COMP gene expression. Over-methylation reduced the expression of this gene, which is involved in bone formation. Positive methylation of the pituitary homeobox 1 gene in its promoter region resulted in greater spine curve angles (31). Similarly, Chan discovered that chromosome p13.3 is a critical determinant in the development of AIS in Asian children (32). Gender is closely associated with scoliosis prevalence, with females experiencing significantly greater rates. Surprisingly, the female-to-male ratio of spinal curvature of 30 degrees or more is 10:1. Scoliosis is caused by a region on the X-chromosome that has just been found. In 2003, Justice et al. examined 15 X chromosomal markers in 202 families. It was determined that regions Xq23 and Xq26.1 play a significant role in the increased occurrence of AIS in females (33–35). Although the precise causal association between exercise and scoliosis is unknown, specialized study has been undertaken to investigate this. Athletes between the ages of 12 and 15 were evaluated, both male and female. As a result, the prevalence of AIS was 2-3 times greater in athletic adolescents compared to non-athletic adolescents. Swimming was found to have the strongest link
with developing AIS among other exercises, while dancing, skating, horseback riding, gymnastics, and karate were less so. The study concluded that there were no additional statistically significant data impacting the occurrence of AIS among adolescent athletes based on age, height, weight, or BMI (36). There has also been some evidence of a relationship between vertebral deformities and maternal insulin-dependent diabetic mellitus, as well as anticonvulsant drugs like valproic acid and dilantin during pregnancy. Although no direct investigations have been conducted to determine the causal association between environmental teratogens and vertebral deformities, animal research shows that there may be some influence (37).

PATHOPHYSIOLOGY OF SCOLIOSIS

Scoliosis pathophysiology is poorly known. It is not implausible to suppose that an existing abnormality could create uneven loading of the growing spine, resulting in asymmetrical vertebral growth.

Several explanations based on these facts have been proposed, some of which are included below.

Thillard discovered that pinealectomized chickens developed scoliosis in 1959 (38). This was duplicated with bipedal rats, and melatonin insufficiency was proposed as a cause of Idiopathic scoliosis IS (39,40). However, additional studies indicated that melatonin levels in teenage IS patients were normal, and pinealectomized monkeys did not develop scoliosis (41,42). A melatonin-signaling pathway failure affecting only specific cell types, specifically osteoblasts, was postulated instead (43,44). Calmodulin is a calcium-binding receptor protein that affects platelet and muscle contractility as well as melatonin. When compared to healthy controls, IS patients had greater levels of calmodulin in platelets and an unequal distribution of calmodulin in paraspinal muscles (45,46). Dickson et al. discovered that in IS patients, vertebral bodies were jammed in the sagittal plane, generating an apical lordosis in thoracic curvatures. They hypothesized that this lordosis in a usually kyphotic region caused a rotation of the spine and, secondarily, a lateral spinal curvature. When MRI scans of IS patients were compared to controls, it was discovered that the spinal cord is shorter in relation to the vertebral column, that there is an increased prevalence of cerebellar tonsillar ectopia, and that the vertebral bodies grow uncoordinatedly in relation to the dorsal elements. As a result, theories positing a relative anterior spinal overgrowth (RASO) or uncoupled neuroosseus growth as the origin of IS have emerged (13,47–50). As previously stated, the likelihood of curve progression in IS is associated to skeletal immaturity; also, girls with adolescent IS are taller and have a faster growth velocity during puberty when compared to healthy controls (51–56). Gerdhem et al. reported a reduced level of COMP, cartilage oligomeric matrix protein, in the serum of IS patients compared to controls. COMP has previously been associated to growth velocity in juvenile rheumatoid arthritis (57,58). Furthermore, greater levels of growth hormone (GH) and insulin-like growth factor 1 (IGF-1) have been related to IS, as have lower levels of leptin, the "satiety" hormone (59–61). Oestrogen levels have also been investigated, however the outcomes have been unclear (62).
THE BIOMECHANICS OF SCOLIOSIS

Scoliosis is a biomechanically significant deviation in the typical vertical spine. An excessive curvature in the frontal plane is caused by an aberrant distortion between or inside the vertebrae. The sagittal plane curves are normal. Secondary compensating balancing curves typically form above and below the first curve. The most dramatic vertebral change occurs at the curve's apex, where pedicles and laminae shorten and thicken on the concave side while the vertebral canal becomes asymmetrical and narrower on the convex side (63,64). When the thoracic vertebrae twist, the ribs become angulated, generating a vertical ridge known as "Razor back" that is best seen when the patient bends forward. This is the amount of spinal rotation. The observation of left convex curvature in left handed people adds weight to the theory that hand dominance causes scoliosis (65–67).

SIGNIFICANT SCOLIOSIS TREATMENT OPTIONS

- Conservative treatment (non-surgical)

Individually tailored exercises are provided to patients in a scoliosis treatment programme. Patients are taught an exercise routine that is tailored to their specific medical and physiotherapeutic needs. Typical generalist physiotherapy, on the other hand, is more generic, consisting of low-impact stretching and strengthening activities such as yoga, but can encompass a wide range of exercise regimes (68). The central nervous system (CNS) automatically corrects irregularities during the early stages of scoliosis, but as time passes, habituation increases and the CNS perceives it as something normal. When there is a sustained departure in alignment, compensatory mechanisms kick in to restore balance. However, these compensations do not restore appropriate body alignment, but rather distort it further. It is critical to halt the curve's advancement and avoid the formation of aberrant postural patterns. This can be accomplished by early intervention, which includes exercises and postural retraining (69). Several recent studies from around the world have found that conservative treatment of scoliosis (including outpatient physiotherapy including electrical stimulation, traction, and postural training; intensive patient rehabilitation; and bracing) is effective in preventing its progression and is recommended as the first line of scoliosis treatment to avoid and prevent surgery (70–74). Exercises have been proven to slow the course of scoliosis, particularly in early adolescence, by increasing Cobb angles and reducing brace prescription in patients through improving strength, mobility, respiratory function, and balance. An orthopaedic surgeon, an orthotist, a nurse, and a physiotherapist work together to successfully manage such patients (74–76). Brace treatment dates back to the 16th century, when Paré pushed for metal braces fashioned by an armourer to treat scoliosis; nevertheless, these braces were not widely employed. Traction had been a popular method for repairing spinal abnormalities since Hippocrates' time. Blount and Schmidt theoretically designed the Milwaukee brace (CTLSO: cervico-thoraco-lumbo-sacro orthosis) for postoperative poliomyelitis in 1946, and it was later adopted for AIS treatment. Following that, brace treatment became popular, and other thoraco-lumbo-sacro orthoses (TLSOs) were devised and used in place of CTLSO, which has some drawbacks such as visible design, difficulty in wearing, compression of the mandible, and so on (77,78). The purpose of brace treatment for AIS is to slow the evolution of a curve and enhance cosmetic appearance while
maintaining whole-body alignment and balance throughout a growing period. The efficacy of brace treatment in AIS has remained disputed, with some writers reporting that bracing controls curve advancement and others stating that bracing does not change the natural history (79). When it comes to neuromuscular and congenital scoliosis, conservative (non-surgical) treatment and its limitations are well documented. For the former, the treatment has little influence on the advancement of the scoliosis but is frequently required to help the patient maintain a suitable seated position in cases of substantial hypotonia and maintain effective chest expansion. Starting at a very young age, the Garches brace remains the favoured treatment (80). Although these braces may not prevent the progression of the spinal congenital deformity, they can help manage the counter curves that may develop on their own. Conservative treatment is still appropriate for syndrome-associated and idiopathic scoliosis. The amount of time dedicated to it should be proportional to the prognosis of EOS, especially for infantile scoliosis. The Milwaukee brace has long been thought to be the gold standard treatment for young kids, yet it does not adequately stabilize many scoliosis problems and is poorly tolerated by patients, in our opinion. It is now possible to deploy more effective braces right away, namely an adjustable multi-shell brace with enough modularity to adapt to growth while not obstructing rib cage development. Plaster casts are still the most effective approach to gently cure developing infantile scoliosis. This treatment breaks the vicious spiral of self-aggravating scoliosis (Hueter-Volkmann law) and places the spinal column in a mechanical environment conducive to spontaneous resolution (Frost law). To avoid neurological issues, casts can be created under general anaesthesia while the youngster is completely relaxed. Premedication can be utilized to reduce anesthesia-related problems, although good distraction is required. Techniques to decrease the stress that such a process can cause to a youngster. An MRI is required prior to these treatments to rule out any anomalies in the central nervous system. The casts are normally equipped with windows and are updated every two months until the best possible correction is accomplished. To avoid advancement that would necessitate surgery in the medium term, this intense treatment requires buy-in from a committed team, the child, and the child's family (81,82).

- **Kinesitherapy**

Hippocrates reported longitudinal traction as the first treatment for scoliosis in the fifth century BC. This was a cruel and barbaric treatment that lasted until the 2nd century AD and used a scamnum (akin to a torture rack). Ambrose Pare, a French army surgeon, invented the first torso brace in the 16th century. He hypothesised that spinal deformity was caused by spine dislocation. Pare created a padded iron corset for patients to wear in order to slow the advancement of the curve. Following that, other treatment procedures were developed, and the Milwaukee brace was released in 1946, becoming a dominant alternative for treating scoliosis (78,83). There are currently several braces available, as well as alternative therapy methods such as acupuncture. Aside from bracing and surgery, which will be addressed further below, alternative methods, such as acupuncture, have been investigated. A 10 degree correction in curvature was described in a case report when acupuncture was performed three times a week for six weeks. In another study, 24 AIS patients between the ages of 14 and 16 underwent a 25-minute acupuncture session. It was determined that AIS patients with curvature less than 35 degrees benefited. More research and follow-up examination, however, are required to support this therapeutic choice (84–86). G. Dean MacEwen invented the low-profile thoracic lumbar spinal orthosis (TLSO) brace in 1969, making it lighter,
more comfortable, and less noticeable for patients. The Wilmington brace was the first TLSO brace. It was made of moldable plastic and was semi-rigid. Because of the difficulties in custom-molding these braces, John Hall and William Miller developed another TLSO known as the Boston brace in 1972. Prefabricated braces were custom-modified rather than custom-fitting each patient. Boston braces, like the Milwaukee brace, used both passive and active correction forces (83).

- **Surgical methods**

Growing rods, which apply a distraction force to the spine and/or ribs, guided growth systems, which keep the spine in its reduced position without restricting its growth, and compression-based systems, which apply a compressive force to the convexity of the curve to inhibit its growth, are the three broad categories of surgical methods (87).

- **Growth guidance systems**

These are surgical instruments used to guide the straightening of the vertebral column. They enable passive distraction during development and stretching motions without the necessity for surgery. McCarthy et al. described the Shilla approach for growth guiding (88). Both the modified Luque Trolley technique and spinal fixation implants slide freely along the rod to allow for progressive migration. These implants necessitate a significant number of anchoring sites on the spine and can be placed at the site of fusion, which can be voluntary at the scoliosis's tip in the Shilla operation or involuntary despite an extraperiosteal approach in the Luque Trolley technique. The creators of these procedures have only reported medium-term results on a small number of patients, but in both cases, far fewer surgeries were required than with developing rods (89,90). These devices appear to be especially significant for cases of scoliosis because they have enough flexibility to allow for adequate reduction during instrumentation. Before these technologies can be deployed on a larger scale, they must undergo independent review with longer follow-up. Because metallosis has been reported with these devices, this potential consequence must be investigated and addressed (91).

- **Growing rods**

Moe and colleagues first described a procedure that involved inserting rods into the concavity of the curve, exposing the spine only at the extremities of the construct, and then making a first correction by distraction during implantation. This necessitates regular additional surgical procedures to lengthen the rod in order to maintain the outcome attained during the index surgery and to monitor spine growth, which is measured and compared to the Dimeglio growth curves (92). Because of the work of Akbarnia and others, growing rods are now regarded the gold standard (87,93). The rods can now be extended non-invasively using a magnetic process. This increases the frequency and progressiveness of lengthening, lowering the risk of the surgery while boosting tolerance and effectiveness. The recently developed Magec® system is currently being assessed; preliminary results are more promising than those of the Phenix® system, which suffered from internal mechanism lock-up. However, the follow-up is still very short, and the device's technology
does not protect against the risk of gradual stiffening of the spine between lengthening sessions, as well as the possibility that the magnetic distraction force will be ineffective after one or two years of use (94–98). Growing rods achieve their purpose of curve stabilisation and T1-S1 segment growth, although they are plagued with problems. The frequency of these problems varies between studies but rises linearly with the number of procedures performed. The proportion of unscheduled surgical procedures required to manage these problems provides an indicator of their frequency and severity (93,99–102).

**Complications**

Mechanical complications:

Breakage of the rod occurs in at least 15% of cases; it primarily occurs near the connection points or in an area where the rod is significantly bent, particularly in cases of hyperkyphosis; the rod is more likely to break if its diameter is too small and only one rod is used (99). In 95% of cases, implant dislodging happens at the upper end of the construction. It is more common in hyperkyphosis and can be avoided by applying strong fixation over two or three vertebrae, which is supplemented with local bone graft application. Screw application appears to produce the most solid proxim. However, if the screw fixation fails, the neurological implications can be disastrous. This issue has only been noticed in structures held together by a single screw. There is currently no agreement on the best superior anchoring strategy. Most surgical teams secure the rod's inferior end by screwing it into two adjacent vertebrae. The anchoring points must be placed so that the rod is as parallel to the support vertebrae at that level as feasible to reduce strains and prevent induction of a fixed angle, which will hinder gradual correction with each distraction (103,104).

**Infection**

Mackenzie et al. observed a 6.7% infection rate in their patients, with surgical revision required in 69% of cases. Infections become increasingly common as more surgical operations are performed. To avoid subcutaneous impingement, the rods must be inserted beneath the muscle layers. This is especially typical in young, hypotrophic patients. We believe that making one lengthy incision to attain the ideal rod location is preferable to making many minor incisions at the anchoring sites and inserting the rod blindly. One patient died as a result of an intra-thoracic erroneous trajectory (105,106).

**Neurological complications**

There have been no reports of neurological problems during rod lengthening. Intra-operative monitoring has primarily been indicated during rod or equipment implantation or replacement. Although no recommendations exist for systematic monitoring during lengthening procedures, there is agreement on the need to be alert and assess at-risk individuals by completing a spinal cord MRI at the commencement of treatment (107).
Psychological and social complications

According to Acaroglu et al., the overall period of hospitalisation was 101 days between the initial surgical treatment and the final fusion, with an average of 4.6 lengthening sessions conducted by the patient. These findings demonstrate the financial burden of scoliosis care as well as the potential psychological and social effects for patients and their families (108,109).

Final fusion after growing rods

This treatment has not yet been standardized, although it is used when there has been sufficient development or when difficulties are too frequent or severe to continue utilizing the growing rods. Because of the stiffness of the vertebral column and the presence of auto-fusion sites in the spine away from the anchoring points, this technique is difficult (110). This necessitates posterior osteotomy treatments. Some authors have reported stiffness in the area bridged by the equipment after removing the developing rods without performing a fusion (111).

Convexity compression devices

These approaches involve limiting the progression of the curvature convexity in the same way that epiphysiodesis does, but using implants that, in theory, eliminate the necessity for definitive asymmetric spinal fusion. Shape memory staples, which are inserted through a small incision to compress and bridge the growth plates, have only been shown to be effective for curvatures less than 35; their rigidity raises concerns about stiffening of the instrumented area, which must be long enough to be effective (112,113). Stretching a tether over the convexity is anticipated to increase mobility and, as a result, reduce the chance of spontaneous fusion. The only published case report was in a patient with a 40 Cobb angle who was operated on at 8.5 years of age; the Cobb angle was 25 immediately after the tethering surgery and was 6 after 4 years of follow-up with partially sustained mobility. The tether stopped the convexity from growing in this patient. Its usage before the age of eight years is not advised because there is no proof in a wider group of individuals that spinal growth returns to normal when the tether is severed. There have been no reports of this procedure being employed in more severe cases of scoliosis (114,115).

PSYCHOSOCIAL PROBLEMS IN SCOLIOSIS PATIENTS

According to Payne et al., scoliosis, independent of treatment status, is a risk factor for psychiatric disturbance during adolescence, as seen by greater rates of suicidal ideation and alcohol usage among patients compared to healthy controls. Orthopedists are concerned about patient psychological discomfort because it might negatively effect the patient's adjustment to treatment through noncompliance with bracing programmes or psychosocial difficulties following surgery (116–120). Prior study looked at the impact of diagnosis and treatment variables on adolescent patients, adult scoliosis limits, and psychosocial risk and protective factors linked with scoliosis. Regardless of therapy approach, adolescents treated after the age of 16 appear to have poorer psychosocial results than individuals treated in early adolescence (121–124). The first diagnosis and treatment period are stressful experiences for adolescents and their families, with feelings of isolation, denial, and distress expressed by at least 40% of patients and their guardians during the
early phases of treatment (125–127). During adolescence, either surgery or bracing is a burden, and each option appears to present unique obstacles. A treatment-specific survey conducted by Danielsson et al (123) found that feelings of loneliness or depression, as well as limited participation in leisure activities or dating, were reported by 25% to 43% of patients, regardless of treatment type. However, up to 40% of those polled said their treatment "didn't bother them much," while 48% of bracing patients and 50% of surgical patients said it helped them gain independence and maturity. Although the impact of surgery on adolescence has received less attention in the literature than the impact of bracing, surgical treatment is also difficult for adolescents due to the potentially stressful hospital environment, the possibility of complications or disability following surgery, and absence from school and subsequent loss of social interaction due to recovery (128–131). However, self-consciousness, together with fear of harm and physical difficulty, is still a factor in limiting social activities in 50% of surgically treated patients and 35% of brace-treated patients (132,133). For similar reasons, women with scoliosis have fewer and less pleasant sexual relationships than those without scoliosis. Although scoliosis does not appear to hinder career chances, patients in Danielsson and Nachemson's follow-up investigations were more likely to have taken sick leave owing to back difficulties than people without scoliosis. Although psychological interventions on adults with scoliosis have not been studied, involvement in a support group has been demonstrated to promote psychosocial health in adults with scoliosis (132–136).

QUALITY OF LIFE (QOL) WITH SCOLIOSIS

The Scoliosis Research Society (SRS) patient questionnaire, an adolescent idiopathic scoliosis (AIS) specific health related quality of life HRQL tool, has allowed orthopedists to quantify HRQL before and after scoliosis correction surgery. The SRS is made up of 24 components separated into two portions (SRS-24). The first component is for everyone and includes the domains Pain, General Self Image, General Function, and General Level of Activity. The second half is only pertinent to postsurgical patients, with Postoperative Self Image and Function assessments comparable to general measures, as well as Satisfaction, a measure of satisfaction with surgery outcome (137–139). The most recent SRS format has 22 items (SRS-22) and includes domains for Function, Pain, Self Image, and Mental Health, as well as a Subtotal score. Because nonoperative and surgical scoliosis patients, as well as healthy control groups, can complete all portions of the SRS-22, it is more versatile than the SRS-24. Despite the fact that the SRS scales were created in English, recent transcultural studies have resulted in Spanish, Japanese, and Turkish versions of the questionnaire. In studies comparing adolescents with AIS to healthy controls, the SRS Patient Questionnaires were found to be capable of discriminating between patients and healthy controls, as well as variable curvature severity and satisfaction levels among surgically treated patients (140–143). While the SRS Patient Questionnaires have been used to measure surgical outcomes in adolescent patients, with the exception of transcultural studies that include adolescent patients, there has been minimal use of the SRS Patient Questionnaire among nonsurgically treated patients. The Scoliosis Quality of Life Index (SQLI), a simplified version of the SRS-22, the Quality of Life Profile for Spinal Deformities (QLPSD), the Paediatric Outcomes Data Collection Instrument (PODCI), the Child Health Questionnaire (CHQ), or the Berner Questionnaire for Well Being2 (BQWB) have instead been used in studies. Studies that elicit responses from patients rather than
their parents show that some aspects of HRQL are disrupted, which appears to be aggravated by treatment considerations such as pending surgery or wearing a Milwaukee brace (122,130,144,145).

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CONCLUSION AND FUTURE DIRECTION

Our review articles begin with an introduction of Scoliosis Classifications, Scoliosis Causes, and Scoliosis Treatments. The scoliosis biomechanics, Treatment options for severe scoliosis, Scoliosis Patients' Psychosocial Issues, Quality of Life (QoL) With Scoliosis, our review concluded that medicine does not cure entirely and has harmful side effects on the body, whereas non-pharmacological (Exercise and Yoga) treatment provides a decent result but takes time and has no harmful consequences on the human body. More randomized controlled trials on the treatment of scoliosis are required. We intend to do a preliminary investigation into Scoliosis sickness in the future. In our location, we are doing a counselling-based research project to analyze patient mental and physical health and provide improved statistics on Scoliosis disease and therapy.
Table 1: Summary of patents on Scoliosis

<table>
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<th>Patent Number</th>
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<td>Three-dimensional (3D) ultrasound imaging system for assessing scoliosis</td>
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<td>Scoliosis</td>
<td>Alain Moreau/ Chu Sainte – Justine/ United States</td>
<td>COMPOSITION COMPRISING A CELL SAMPLE FROM A SUBJECT WITH SCOLIOSIS AND A REAGENT FOR DETECTING PTPU OR PIPKIY</td>
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<td>Mats Danielsson/ Prismatic Sensors AB/ United States</td>
<td>X - RAY IMAGING FOR ENABLING ASSESSMENT OF SCOLIOSIS</td>
<td>(152)</td>
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<td>METHOD OF TREATING SCOLIOSIS USING A BIOLOGICAL IMPLANT</td>
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<td>Satoshi Kanai/ National University/ United States</td>
<td>SCOLIOSIS DIAGNOSIS ASSISTANCE DEVICE, SCOLIOSIS DIAGNOSIS ASSISTANCE METHOD, AND PROGRAM (155)</td>
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<td>US2009/0035768A1</td>
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Table 2: Current status of clinical trials on Scoliosis.

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<th>S.no.</th>
<th>Drug</th>
<th>Mode of administration</th>
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<th>Enrollment</th>
<th>Allocation/Intervention model/Masking</th>
<th>Official Title of the study</th>
<th>status</th>
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<td>virtual reality</td>
<td>Interven tional</td>
<td>Scoliosis</td>
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<td>NA/Single group assignment/None</td>
<td>Virtual Reality's Effect on Decreasing Pain and Subsequent Opioid Use in Pediatric Patients in the Post-Operative Period Following Scoliosis Repair</td>
<td>NA</td>
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<td>MID-C</td>
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<td>Scoliosis Specific Corrective Exercises and Physical Activity Counseling/Scoliosis Specific Corrective Exercises</td>
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<td>Effects of Physical Activity Counselling in Addition to Scoliosis-Specific Corrective Exercises in Patients With Adolescent Idiopathic Scoliosis</td>
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<td>Conventional Brace/Optimized Brace/</td>
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<td>Validation of a New Optimized Nighttime Providence Brace for Personalized Treatment of Adolescent Idiopathic Scoliosis</td>
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<td>7.</td>
<td>Impact of Aerobic Training and Combined Inflammatory Markers in Patients With Adolescent Idiopathic Scoliosis</td>
<td>Interventions</td>
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<td>Advanced Methods for Improving Anesthesiologic Management and Their Effect on Perioperative Outcome in Scoliosis Surgery, Especially in Childhood (SCOL Study): a Prospective Observational Study</td>
<td>Observational</td>
<td>Scoliosis</td>
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<td>Predictive Progressive Factors of Adolescent Idiopathic Scoliosis</td>
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<td>Evaluation of Lateral and Medial Part Activations of Latissimus Dorsi Muscle During Isometric Exercises in Individuals With Scoliosis</td>
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<td>Effectiveness of Active Bodysuits for Adult Degenerative Scoliosis</td>
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<td>Osteoblast sample Intervenational Scoliosis 45 NA</td>
<td>Ghrelin Cellular Resistance Study in Adolescents With Idiopathic Scoliosis</td>
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<td>NCT02829 476</td>
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<td>procedure1/procedure2 Intervenional Scoliosis 840 Non-Randomized/Parallel Assignment/None (Open Label)</td>
<td>Screening and Prevalence of Adolescent Idiopathic Scoliosis in Selected Urban and Countryside Schools in Egypt</td>
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<td>NCT03894 865</td>
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<td>Exercise programme 1/exercise programme 2 Intervenional Scoliosis 40 Non-Randomized Interventional/Sequential Assignment/None (Open Label)</td>
<td>The Effect of Schroth Method on Pain, Body Awareness and Quality of Life in Adolescent Individuals With Idiopathic Scoliosis</td>
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<td>Video recording of clinical visit Observational Scoliosis 25 NA</td>
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<td>Ultrasound Observational Scoliosis 55 Cohort</td>
<td>Ultrasound Measured Epidural Depth for Midline Approach in Pediatric Patients</td>
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<td>N/A/Interventional/Single Group Assignment/Non open (Open Label)</td>
<td>Multicenter Study on the Contribution of Surgical Treatment by ST2R Technique (Simultaneous Translation on Two Rods) in Scoliosis of Children and Adolescents</td>
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<td>25.</td>
<td>Physical</td>
<td>Observational Scoliosis</td>
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<td>Diagnostic Accuracy of Low-dose Dual-energy CT for the Pre-surgical Planning of Patients With Progression of Scoliosis</td>
<td>NA</td>
<td>NCT03483844</td>
<td>2019</td>
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</table>
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