Methodology

Indications for conservative management of scoliosis (guidelines)

SOSORT guideline committee, Hans-Rudolf Weiss*†1, Stefano Negrini†2, Manuel Rigo3, Tomasz Kotwicki4, Martha C Hawes†5, Theodoros B Grivas6, Toru Maruyama7 and Franz Landauer8

Definition

Scoliosis is defined as a lateral curvature of the spine with torsion of the spine and chest as well as a disturbance of the sagittal profile [2].

Etiology

Idiopathic scoliosis is the most common of all forms of lateral deviation of the spine. By definition, it is a lateral curvature of the spine in an otherwise healthy child, for which a currently recognizable cause has not been found. Less common but better defined etiologies of the disorder include scoliosis of neuromuscular origin, congenital scoliosis, scoliosis in neurofibromatosis, and mesenchymal disorders like Marfan’s syndrome [3].

Epidemiology

The prevalence of adolescent idiopathic scoliosis (AIS), when defined as a curvature greater than 10° according to Cobb, is 2–3%. The prevalence of curvatures greater than 20° is between 0.3 and 0.5%, while curvatures greater than 40° Cobb are found in less than 0.1% of the population. All etiologies of scoliosis other than AIS are encountered more rarely [4].

Classifications

The anatomical level of the deformity has received attention from clinicians as a basis for scoliosis classification. The level of the apex vertebra (i.e., thoracic, thoracolumbar, lumbar or double major) forms a simple basis for description. In 1983, King and colleagues [5] classified different curvature patterns by the extent of spinal fusion required; however, recent reports have suggested that...
these classifications lack reliability. Recently, a new description has been developed by Lenke and colleagues [6]. This approach calls for clinical assessment of scoliosis and kyphosis with respect to sagittal profile and curvature components. Systems designed for conservative management include the classifications by Lehnert-Schroth [7] (functional three-curve and functional four-curve scoliosis) and by Rigo [8] (brace construction and application).

Aims of conservative management
The primary aim of scoliosis management is to stop curvature progression [9]. Improvement of pulmonary function (vital capacity) and treatment of pain are also of major importance. The first of three modes of conservative scoliosis management is based on physical therapy, including Méthode Lyonaise [10], Side-Shift [11], Dobosiewicz [12], Schroth and others [7]. Although discussed from contrasting viewpoints in the international literature, there is some evidence for the effectiveness of scoliosis treatment by physical therapy alone [13].

It has to be emphasized that (1) physical therapy for scoliosis is not just general exercises but rather one of the cited methods designed to address the particular nuances of spinal deformity, and (2) application of such methods requires therapists and clinicians specifically trained and certified in those scoliosis specific conservative intervention methods.

The second mode of conservative management is scoliosis intensive rehabilitation (SIR), which appears to be effective with respect to many signs and symptoms of scoliosis and with respect to impeding curvature progression [14]. The third mode of conservative management is brace treatment, which has been found to be effective in preventing curvature progression and thus in altering the natural history of IS [15,16]. It appears that brace treatment may reduce the prevalence of surgery [17], restore the sagittal profile [18] and influence vertebral rotation [19]. There are also indications that the end result of brace treatment can be predicted [20].

Systematic application of the modes of conservative treatment with respect to Cobb angle and maturity
Guidelines for conservative intervention are based on current information regarding the risk for significant curvature progression in a given period of time. Each case has its own natural history and must be considered on an individual basis, in the context of thorough clinical evaluation and patient history [21]. Estimation of risk for progression is based on small (n < 1000) epidemiological surveys in which children were diagnosed with scoliosis, and radiographed periodically to quantify changes in curvature magnitude over time [22-44]. Such surveys support the premise that, among populations of children with a diagnosis of idiopathic scoliosis, risk for progression is highly correlated with potential for growth over the period of observation. In boys, prognosis for progression is more favorable, with relatively fewer individuals having curves that progress to >40 degrees. For SOSORT guidelines, prognostic risk estimation is based on the calculation of Lonstein and Carlson [33]. This calculation is based on curvature progression observed among 727 patients (575 female, 152 male) diagnosed between 1974–1979 in state of Minnesota (United States) school screening programs, and followed until they reached skeletal maturity. (See Figure 1).

I. Children (no signs of maturity) [21]
  a. < 15° Cobb: Observation (6 – 12 month intervals)
  b. Cobb angle 15–20°: Outpatient physical therapy with treatment-free intervals (6–12 weeks without physical therapy for those patients at that time have low risk for curve progression). In this context, ‘Outpatient physical therapy’ is defined here as exercise sessions initiated at the physical therapist's office, plus a home exercise program (two to seven sessions per week according to the physical therapy method being applied). After three months, one exercise session every two weeks may be sufficient.
  c. Cobb angle 20–25°: Outpatient physical therapy, scoliosis intensive rehabilitation program (SIR) where available.
  d. > 25° Cobb: Outpatient physical therapy, scoliosis intensive rehabilitation program (SIR) where available and brace wear (part-time, 12–16 hours)

II. Children and adolescents, Risser 0–3, first signs of maturation, less than 98% of mature height
The following section is based on progression risk rather than on Cobb angle measurement because of the changing risk profiles for deformities the skeleton matures. For our purposes, progression risk is calculated by the formula shown in figure 1.

  a. Progression risk less than 40%: Observation (3-month intervals)
  b. Progression risk 40%: Out patient physiotherapy
  c. Progression risk 50%: Out patient physiotherapy, scoliosis intensive rehabilitation program (SIR) where available
d. Progression risk 60%: Out patient physiotherapy, scoliosis intensive rehabilitation program (SIR) where available + part-time brace indication (16 – 23 hours [low risk]).

e. Progression risk 80%: Out patient physiotherapy, scoliosis intensive rehabilitation program (SIR) where available + full-time brace indication (23 hours [high risk])

III. Children and adolescents presenting with Risser 4 (more than 98% of mature height)

a. < 20° according to Cobb: Observation (6 – 12 Months intervals)

b. 20 – 25° according to Cobb: Outpatient physical therapy

c. > 25° according to Cobb: Outpatient physical therapy, scoliosis intensive rehabilitation programme (SIR) where available

d. > 35° according to Cobb: Outpatient physical therapy, scoliosis intensive rehabilitation programme (SIR) where available + brace (part time, about 16 hours are sufficient)

e. For brace weaning: Outpatient physical therapy, scoliosis intensive rehabilitation programme (SIR) where available + brace with reduced wearing time.

IV. First presentation with Risser 4–5 (more than 99.5% of mature height before growth is completed)

a. > 25° Cobb: Outpatient physical therapy

b. > 30° Cobb: Outpatient physical therapy, scoliosis intensive rehabilitation program (SIR) where available.

V. Adults with Cobb angles > 30°

Outpatient physical therapy, scoliosis intensive rehabilitation program (SIR), where available

---

Figure 1

The estimation of the prognostic risk to be used during pubertal growth spurt (modified from Lonstein and Carlson [33]). The numbers in the figure indicate the number of cases that each data point is based on. Note the small number of cases on which the upper margins of the graph are based. Lonstein and Carlson’s progression estimation formula is based on curves between 20 and 29 degrees.
VI. Adolescents and adults with scoliosis (of any degree) and chronic pain

Outpatient physical therapy, scoliosis intensive rehabilitation program (SIR) where available, with a special pain program (multimodal pain concept/behavioral + physical concept), brace treatment when a positive effect has been proven [45].

The prognostic estimation and corresponding indications for treatment apply to the most prevalent condition, idiopathic scoliosis. In other types of scoliosis a similar procedure can be applied. Exceptions include those cases where the prognosis is clearly worse, for example in neuromuscular scolioses where a wheelchair is necessary (early surgery for maintaining sitting capability may be required). Other reasons for the consideration of alternative treatments include:

- Severe decompensation
- Severe sagittal deviations with structural lumbar kyphosis ('flatback')
- Lumbar, thoracolumbar and caudal component of double curvatures with a disproportionate rotation compared to the Cobb angle and with high risk for future instability at the caudal junctional zone
- Severe contractures and muscles shortening
- Reduced mobility of the spine especially in the sagittal plane
- Others to be individually considered [46]

Authors’ contributions

These authors contributed by reviewing, text editing and adding certain textfiles and references

References

1. [http://www.sosort.org/meetings.php](http://www.sosort.org/meetings.php)
2. Stokes IAF. Die Biomechanik des Rumpfes. In Wirbelsäulendeformitäten – Konservatives Management Edited by: Weiss HR. München, Pflaum; 2003:59-77.
3. Winter RB. Classification and Terminology. In Moe’s Textbook of Scoliosis and Other Spinal Deformities 2nd edition. Philadelphia Saunders; 1995:39-43.
4. Weinstein SL. Natural history. Spine 1999, 24:2592-2600.
5. King HA, Moe JHY, Bradford DS, Winter RB: The selection of fusion levels in thoracic IS. Journal of Bone and Joint Surgery 1983, 65-A:1302-1313.
6. Dangerfield Ptt: Klassifikation von Wirbelsäulendeformitäten. In Wirbelsäulendeformitäten – Konservatives Management Edited by: Weiss HR. München, Pflaum; 2003:78-83.
7. Lehner-Schroth C: Dreidimensionale Skolosebehandlung 6th edition. Urban/Fischer, München; 2000.
8. Rigo M: Interobserver reliability of a new classification correlating with brace treatment. Pediatric Rehabilitation 2004, 7:63.
9. Landauer F, Wimmer C: Therapieziel der Korsettbefandlung bei idiopathischer Adoleszentenskoliose. MOT 2003, 123:33-37.
10. Mollon G, Rodot JC: Scolioses structurelles mineures et kinesitherapie. Etude statistique comparative des resultats. Kinesitherapie Scientifique 1986, 244:7-56.
11. Mehta MH: Active auto-correction for early AIS. Journal of Bone and Joint Surgery 1986, 68:682.
12. Weiss HR, Negrini S, Hawes MC, Rigo M, Kotwicki T, Grivas TB, Maruyama and members of the SOSORT: Physical Exercises in the Treatment of Idiopathic Scoliosis at Risk of brace treatment – SOSORT Consensus paper 2005. Scoliosis 2005.
13. Negrini S, Antoninni GI, Carabalona R, Minozzi S: Physical exercises as a treatment for adolescent idiopathic scoliosis. A systematic review. Pediatric Rehabilitation 2003, 6:227-235.
14. Weiss HR, Weiss G, Petermann F: Incidence of curvature progression in idiopathic scoliosis patients treated with scoliosis in-patient rehabilitation (SIR): an age- and sex-matched controlled study. Pediatric Rehabilitation 2003, 6:233-30.
15. Nachemson AL, Peterson LE, Members of Brace Study Group of the Ascani E Research Society: Effectiveness of treatment with a brace in girls who have adolescent idiopathic scoliosis. J Bone Joint Surg 1995, 77:815-822.
16. Grivas TB, Vassiliadis E, Chatziargyropoulos T, Polyzois VD, Gatos K: The effect of a modified Boston brace with anti-rotatory blocks on the progression of curves in idiopathic scoliosis: aetologic implications. Pediatric Rehabilitation 2003, 6:217-242.
17. Rigo M, Reiter C, Weiss HR: Effect of conservative management on the prevalence of surgery in patients with adolescent idiopathic scoliosis. Pediatric Rehabilitation 2003, 6:209-214.
18. Rigo M: 3 D Correction of Trunk Deformity in Patients with Idiopathic Scoliosis Using Chéneau Brac. In Research into Spinal Deformities 2. Studies in Health Technology and Informatics Edited by: Stokes IAF. Amsterdam: IOS Press; 1999:362-365.
19. Kotwicki T, Pietrzak S, Szulc A: Three-dimensional action of Cheneau brace on thoracolumbar scoliosis. In Research into Spinal Deformities 3. Studies in Health Technology and Informatics Edited by: Tanguy A, Peuchot B. Amsterdam: IOS Press; 2002:226-229.
20. Landauer F, Wimmer C, Behensky H: Estimating the final outcome of brace treatment for idiopathic thoracic scoliosis at 6-month follow-up. Pediatric Rehabilitation 2003, 6:201-207.
21. Lonstein JE: Patient Evaluation. In Moe’s Textbook of Scoliosis and Other Spinal Deformities 2nd edition. Philadelphia, Saunders; 1995:45-86.
22. Canale E, Bartolozzi P, Logroscino CA, Marchetti PG, Ponte A, Savini R, Travaglini F, Bianchi F, Di Silvestre M: Natural history of untreated IS after skeletal maturity. Spine 1986, 11:784-789.
23. Bjerkreim R, Hassan I: Progression in untreated IS after the end of growth. Acta orthop scand 1982, 53:897-900.
24. Brooks HL, Azen SP, Gerber E, Brooks R, Chan L: Scoliosis: a prospective epidemiological study. Journal of Bone and Joint Surgery 1975, 57:968-72.
25. Bunnell WP. The natural history of IS before skeletal maturity. Spine 1986, 11:773-776.
26. Clarisse P: Pronostic evolutif des scolioses idiopathiques mineures de 10–29 degrees, en periode de croissance. In Thesis Lyon France; 1974.
27. Collis DK, Ponseti IV: Long-term followup of patients with idiopathic scoliosis not treated surgically. Journal of Bone and Joint Surgery 1969, 51-A:425-445.
28. Duval-Beaupere G: Rib hump and supine angle as prognostic factors for mild scoliosis. Spine 1992, 17:103-107.
29. Duval-Beaupere G: Threshold values for supine and standing Cobb angles and rib hump measurements: prognostic factors for scoliosis. European Spine Journal 1996, 5:79-84.
30. Karol LA, Johnston CE, Browne RH, Madison M: Progression of the curve in boys who have IS. Journal of Bone and Joint Surgery 1993, 75:1804-1810.
31. Kindsfater K, Lowe T, Lawelin D, Weinstein D, Akmakjian A: Level of platelet calmodulin for the prediction of progression and severity of AIS. Journal of Bone and Joint Surgery 1994, 76-A:1186-1192.
32. Karovessis P, Pipers G, Sidiroopoulos P, Dimas A: Adult idiopathic lumbar scoliosis: a formula for prediction of progression and review of the literature. Spine 1994, 19:1926-1932.
33. Lonstein JE, Carlson JM: The prediction of curve progression in untreated idiopathic scoliosis during growth. Journal of Bone and Joint Surgery 1984, 66-A:1061-1071.
34. Masso PD, Meeropol E, Lennon E: Juvenile onset scoliosis followed up to adulthood: orthopedic and functional outcomes. Journal of Pediatric Orthopedics 2002, 22:279-284.

35. Meade KP, Bunch W, Vanderby R, Paxwardhan AG, Knight G: Progression of unsupported curves in AIS. Spine 1987, 12:520-526.

36. Mehta M: The rib-vertebra angle in the early diagnosis between resolving and progressive infantile scoliosis. Journal of Bone and Joint Surgery 1972, 54B:230-243.

37. Nachemson A: A long term followup study of nontreated scoliosis. Acta Orthop Scand 1968, 39:466-476.

38. Picault C, deMauroy JC, Mouillleseaux B, Diana G: Natural history of idiopathic scoliosis in girls and boys. Spine 1986, 11:777-778.

39. Robinson CM, McMaster MJ: Juvenile is: Curve patterns and progression in 109 patients. Journal of Bone and Joint Surgery 1996, 78-A:1140-1148.

40. Soucacos PN, Zacharis K, Loutanis K, Gelalis J, Xenakis T, Beris AE: Risk factors for IS: review of a 6-year prospective study. Orthopedics 2000, 23:833-838.

41. Soucacos PN, Zacharis K, Soulitanis K, Gelalis J, Kalos N, Beris A, Xenakis T, Johnson EO: Assessment of curve progression in IS. European Spine Journal 1998, 7:270-277.

42. Villenure I, Aubin CE, Grimard G, Dansereau J, Labelle H: Progression of vertebral and spinal 3-D deformities in AIS. A longitudinal study. Spine 2001, 26:2244-2250.

43. Wever DJ, Tonseth KA, Veldhuizen AG, Cool JC, vanHorn JR: Curve progression and spinal growth in brace treated IS. Clinical Orthopaedics and Related Research 2000, 377:169-179.

44. Yamashita Y, Yamaguchi T, Asaka Y: Prediction of curve progression in IS based on initial roentgenograms; proposal of an equation. Spine 1988, 13:1258-1261.

45. Weiss HR: Das „Sagittal Realignment Brace“ (physio-logic® brace) in der Behandlung von erwachsenen Skoliosepatienten mit chronifiziertem Rückenschmerz – erste vorläufige Ergebnisse. Medizinisch Orthopädische Technik 2005, 125:45-54.

46. Negrini S, Aulisa L, Ferraro C, Fraschini P, Masiero S, Simonazzi P, Tedeschi C, Venurin A: Italian guidelines on rehabilitation treatment of adolescents with scoliosis or other spinal deformities. Eur Med Phys 2005, 41:193-201.