Title

Idiopathic Scoliosis – Interventions with exercise and manual therapy

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CLINICAL SCENARIO: In North America screening for idiopathic scoliosis (IDS) has commonly occurred since the 1970's. Typical treatment is screening, observation, bracing and surgery. In Europe, it is common to use exercise as part of the conservative management of scoliosis.

FOCUSSED CLINICAL QUESTION: "The young adult or teenager with idiopathic scoliosis is often treated with an exercise program that focuses upon stretching, strengthening and range of motion to improve the scoliosis and the question arises, would it be a more effective intervention if one used manual therapy techniques to address biomechanical restrictions of the spine including pelvic obliquity, fascial restrictions, visceral facilitation and neural tissue tension?

SUMMARY of Best Evidence:

Three studies summarize the current evidence base regarding IDS. One systemic review was found. One narrative review of the literature has been chosen. One controlled prospective study has been reviewed.

Negrini, S., Antonini, G., Carabalona, R. & Minozzi, S., 2003: This systemic review describes the results of an extensive literature search from all pertinent databases without language restrictions (152 articles) and from hand-searching of minor, non-English journals (424 articles). When strict criteria for internal validity were applied, eleven articles were chosen for review. Ten of the articles demonstrated that physical exercise was effective in reducing the rate or magnitude of the Cobb angle at the end of treatment.

Hawes, M., 2003: This narrative review of English language articles on IDS concludes that there is evidence consistent with the hypothesis that exercise-based therapies can improve spinal deformities. There also seems to be evidence that there is a postural aetiology for IDS. The author discusses the demographics of scoliosis and warns that plagiocephaly is a new causative factor in jurisdictions where back-lying ("back to sleep" programs) is being recommended for infants.

Weiss, H-R, Weiss, G., & Petermann, F., 2003: This was an age- and sex-matched controlled study that was designed "to test the hypothesis that physiotherapy-based intervention can reduce incidence of progression" (p. 23) of scoliotic curves in children. One group was untreated. The intervention was "scoliosis in-patient rehabilitation (SIR)". SIR is primarily exercise-based but includes many disciplines and techniques (myofascial release, mobilization therapy, breathing exercises). Manipulation and acupuncture are used for pain relief.

CLINICAL BOTTOM LINE: It is not yet possible to prove that exercise can reverse or stabilize scoliotic curves but there is an emerging body of evidence supporting the use of exercise with IDS. It has been shown that exercise can help with associated problems – respiratory tolerance, postural balance, and strength. Clinical studies with regards to manual therapy approaches – fascial release, muscle energy, visceral techniques, neural tissue tension technique and craniosacral therapy, osteopathy, chiropractic and integrative manual therapy are only available at case study level, if at all.

- Therapeutic exercise is a good alternative to the "observation period" that is in common usage; there are benefits of exercise that have been demonstrated.
- Therapists need to learn more about the exercise interventions that are being used (in Europe) in efforts to stabilize and correct scoliotic curves.
- Soft tissue therapeutic interventions are used in Europe; models for these approaches exist in Canada but have not been tested.
- Therapists may need to re-visit the recommendations that infants sleep on their back (also known as the Back to Sleep program) with a prophylactic intention - to prevent plagiocephaly. For example, perhaps positioning an infant in alternate side-lying might be preferable until the infant can roll from both prone and supine positions. In plagiocephaly the curve in infant scoliosis is ipsilateral to side the child habitually turns its head. After some decades of a stable incidence of scoliosis, the rate of occurrence may be rising because of plagiocephaly (Hawes, 2003).

Limitation of this CAT: This critically appraised paper (or topic) has not been peer-reviewed.

SEARCH STRATEGY:

Terms used to guide Search Strategy:

- **P**atient/Client Group: Adolescent idiopathic scoliosis
- **I**ntervention (or Assessment): Exercise
- **C**omparison: Manual Therapy
- **O**utcome(s): Curvature either stabilized or reduced (Cobb angle measure)

Databases and sites searched	Search Terms	Limits used
PEDro CINAHL PubMed Central Cochrane Data base	Scoliosis, idiopathic scoliosis AND Exercise AND Physiotherapy/physical therapy AND Rehabilitation AND ….. Manual therapy, myofascial release, craniosacral therapy, muscle energy, osteopathy, visceral manipulation	Adolescents, English language

INCLUSION and EXCLUSION CRITERIA

- Inclusion: adolescents, conservative treatment (exercise, physiotherapy etc.)
- Exclusion: scoliosis secondary to medical problems; patients with IDS who had had surgery

RESULTS OF SEARCH

Table 1: Summary of Study Designs of Articles retrieved

Study Design/ Methodology of Articles Retrieved	Level	Number Located	Author (Year)
Systematic Review	**1**	**1**	Negrini et al (2003)
Narrative Review	**5**	**1**	Hawes (2003)
Controlled Case Study	**5**	**2**	Weiss et al(2003) Rowe et al (2006)
Case Study	**7**	**1**	Hamm, M. (2006)

BEST EVIDENCE

The following study/paper was identified as the 'best' evidence and selected for critical appraisal. Reasons for selecting this study were:

- This was a well-written and thorough systematic review of the available literature on idiopathic scoliosis
- The inclusion criteria were strict.
- The authors support evidence- based research in rehabilitation and for IDS and exercise in particular.

SUMMARY OF BEST EVIDENCE

Table 2:

Negrini, S., Antonini, G., Carabalona, R., & Minozzi, S. (2003). Physical exercises as a treatment for adolescent idiopathic scoliosis. A systematic review.

Aim of the Systematic Review: The goal of the review was to determine the effectiveness of physical exercises in the conservative management of idiopathic scoliosis.

Study Design: This paper was a systematic review.

Search Strategy: The authors completed a review of several databases (Medline, Cochrane Library, Embase, CINAHL) and a hand-search of non-indexed but relevant literature. Databases were searched from the date of their inception to December 2002. "For the free-text search, we used the following terms: 'idiopathic scoliosis AND exercise', 'idiopathic scoliosis AND exercises', idiopathic scoliosis AND sport', 'idiopathic scoliosis AND rehabilitation', 'idiopathic scoliosis AND physiotherapy'" (p. 228).

Selection Criteria: From the databases and reference lists 152 articles were chosen; from the hand search 424 articles were identified. The articles were sorted into three categories: 19 with high probability, 32 that had low probability, and 525 that had no probability of meeting the inclusion criteria. Upon reading the full texts of the retrieved articles, only 11 were found to meet the inclusion criteria.

The inclusion criteria: patients diagnosed with IDS; patients treated exclusively by physical exercises; experimental intervention - control intervention, outcome measure - Cobb angle; study design – any study design

Summary:

The authors feel that rehabilitation is one of the fields of medicine where randomized controlled trials are often "difficult, impractical or unethical" (p. 232). Other choices are available if confounding factors and biases are acknowledged and discussed – a controlled, non-randomized study; an observational controlled study or an uncontrolled study.

None of the studies retrieved were randomized and the quality of the controlled and uncontrolled studies failed to meet basic methodological quality. Nonetheless, these 11 studies represent the only data that an extensive search was able to locate. Only one (Stone, B., Beekman, C., & Hall, V., 1979) gave negative results about the role of exercises in IDS. All other papers were more recent and included control groups and proposed new theories about IDS. Overall, the results are in favour of physical exercise for stabilizing and improving the curvatures (or avoiding progression). There are other benefits of exercises, specifically with regards to postural balance and respiratory function.

The authors conclude that more research is needed in this area. They recommend prospective, randomized trials. They also state that clinically, the option of physical exercise should be discussed with patients and their families to provide an option of conservative care.

BEST EVIDENCE

The following study/paper was identified as the 'best' evidence and selected for critical appraisal. Reasons for selecting this study were:

- It is a well-written and thoroughly researched narrative study
- It provides information not only on studies related to the efficacy of exercises for scoliosis but also discusses studies that provide support for the postural aetiology of scoliosis
- The discussion on the demographics of scoliosis is also both informative and significant for rehabilitation

SUMMARY OF BEST EVIDENCE

Table 2:

Hawes, M., (2003): The use of exercises in the treatment of scoliosis: an evidence-based critical review of the literature. **Aim this Review:** The aim of this literature review was to explore the role of exercise with patients diagnosed with scoliosis. Many factors were considered: the historical viewpoint; studies that both negate and support the role of exercise; theoretical considerations for exercise for IDS and for the pathogenesis and aetiology of scoliosis; and the demographics of scoliosis.

Study Design: This was a narrative review that had two features which are more common to systematic reviews – it had a well defined purpose and a clear search strategy. The selection criteria were not well defined. The appraisal of the articles is qualitative rather than quantitative.

Search Strategy: The scientific and medical literature was searched for English language studies. The review covered several databases, older literature through electronic searches; proceedings of meetings (on scoliosis), contemporary textbooks, and both popular and scholarly books on scoliosis. Over 10,000 articles were identified and surveyed for information about the use of exercise as a treatment for scoliosis.

The databases included: Premedline; premedline and medline (1966-2003); CINAHL (1982-2003); PubMed Central; Science Citation Index (1945-2003); HealthStar (1975-203); PsychoInfo (1872-2003); Cochrane Central Register of Controlled Trials; Cochrane Database of Systematic Reviews and Allied and Complementary Medicine (AMED) (1985-2003).

Keywords were: scoliosis or scoliosis and ….treatment; therapy; exercise; physical therapy; osteopathy; chiropractic; manipulation; massage; non-surgical; conservative; and early intervention.

Selection Criteria: The selection criteria were not well defined. The author was looking for research material that provided information about the use of exercises as a therapeutic intervention. Consideration was given to case reports, reviews, descriptive surveys, cohort studies, epidemiological surveys, controlled trials and basic science.

Original Authors' Conclusions: "A structural deformity which is present at skeletal maturity and remains untreated is a life sentence, at best. Like cancer, infections and other disorders of the human condition, scoliosis develops at a particular point in an individual's development in response to a particular combination of environmental and genetic influences and, as in other diseases and dysfunctions, early detection and early treatment in scoliosis can be predicted to be a key to successful outcomes. A small body of clinical and basic research now supports the hypothesis that exercise-based therapies can be used to reverse the signs and symptoms of scoliosis in children and adults. Conversely, there does not appear to be a single study supporting the dogma that scoliosis will not respond to exercise=based therapies early in the disease process …… Multidisciplinary research by physical therapists, physiatrists, exercise scientists, respiratory therapists and other qualified professionals is long overdue." (p. 178)

Summary/Conclusion: The author's bias in favour of exercise is obvious. She describes the historical perspective and, in doing so, she is able to demonstrate that the medical model which simply observes scoliosis and then only provides the treatments of bracing and surgery is a phenomenon that originated with x-ray technology. Hawes discusses studies which provide theories regarding the use of postural exercises and the mechanisms or causative factors for scoliosis. Hawes calls for more research to investigate these theories and to continue to build evidence regarding exercise. A concern is raised regarding the problem of plagiocephaly and its

relationship with infant scoliosis. Thanks to the medical control of infectious diseases, many of the new cases of scoliosis are idiopathic and the individual is healthy except for the presence of a spinal curve.

BEST EVIDENCE

The following study/paper was identified as the 'best' evidence and selected for critical appraisal. Reasons for selecting this study were:

- This study provides evidence of the efficacy of exercise and the multidisciplinary approach.
- The study had a control group which was closely matched.

SUMMARY OF BEST EVIDENCE

Table 2:

Weiss, H-R., Weiss, G., & Petermann, F., (2003). Incidence of curvature progression in idiopathic scoliosis patients treated with scoliosis in-patient rehabilitation (SIR): an age- and sex-matched controlled study.

Aim of the Study: To compare the incidence of curvature progression in two patient populations by using a control (natural history) group and an intervention group which receives an in-patient, physiotherapy-based treatment program.

Study Design: This was a controlled prospective study. The groups were age and sex-matched. Blinding was used for the outcome measures of the intervention group. The Cobb angles were measured before the study began and after the second intervention. There was good intra-observer and inter-observer reliability with the Cobb angle at the rehabilitation centre.

Setting: Participants were treated as in-patients. Control subjects remained in their community setting.

Participants:
Intervention group had a potential of 181 patients; control group had a potential of 135 patients. Males were excluded. All patients were under 15 years of age. Both groups were divided by age – under 12 and 12-14 years of age.
Group I:

- Intervention group (study A) – Group I had 30 patients with average age 9.9666 years and mean curvature angle of 21 degrees
- Control group (study B) – group I had 64 patients with curvatures that ranged from 5-30 degrees

Group II:

- Intervention group (study A) – this group of 59 patients was further subdivided according to the severity of the curvature. Group IIa had more severe curves ranging from 30-68 degrees; average age 13.5 years.
- Control group (study B) – included 43 patients with curves that ranged from 5-30 degrees

- Follow-ups: Group I average follow-up was 35 months; group II follow-up was an average of 36 months
- Drop-outs were not reported
- All subjects were matched for age

Intervention Investigated: The in-patient program was a minimum of 4 weeks and a maximum of 6 weeks. Treatment consisted of correction of scoliotic posture with the use of proprioceptive and exteroceptive stimulation. Patients received assistance for both individual and group exercise programs from physical therapists and sports therapists. The programming extended throughout the day. Other professionals were also involved (massage therapists for myofascial release, manual traction, ischemic pressure and pressure point therapy; respiratory therapists; psychologists). Osteopathic manipulation and acupuncture were used if patients requested the treatment (e.g. for pain management).

Outcome Measures: The primary outcome measure was the Cobb angle measured by radiography in standing. The test was carried out before the SIR program and after a second intervention; the observation period was at least one year. In a similar manner the control group was measured at the beginning and end of the observation period. All measurements for the intervention were blinded.

Main Findings:
Results: Group 1 (under 12 years) – in the untreated control group, 71.2% of the patients had a curvature progress of more than 5 degrees. The incidence of progression was only 46.66% with the SIR group. This is statistically important at the 0.011 level of probability.
Group II (ages 12-14) – in the untreated control group, 55.8% of the patients had curvature progression. The incidence of progression was only 30.5% with the SIR group.

Original Authors' Conclusions

"The results are consistent with the hypothesis that physiotherapy can significantly alleviate the primary symptoms of spinal deformity: pulmonary deficiency, pain and psychosocial issues. Results of a preliminary study of 181 patients treated with SIR were consistent with the possibility that physiotherapy is associated with a reduced incidence of progression as compared to natural history" (p.28).

Critical Appraisal

Validity:

Methodology: The intervention and control groups were closely matched. The intervention was described in general terms. The outcome measure was appropriate; measurements were blinded.

Rigour: The description of the intervention gave the reader a clear understanding of the exercise concepts and goals; potential variations in treatment (e.g. if pain was a factor) were given.
Sample: the sample was well described and of significant size.
Ethics: There was no mention of ethics procedures or of assent/consent forms. Drop outs were not reported.
Bias: Assessment, intervention and observation period extended on average for 35 months for both groups. For the children under 12 years of age, maturation issues were considered with regards to curve progression. Maturation issues were not as significant for the children over 12 years of age. The primary author has used exercises for decades.

Interpretation of Results:

The results were reported in terms of statistical significance. The results revealed that the incidence of curve progression was lower in the intervention group. This supports the hypothesis that physiotherapy is associated with a lower incidence of curvature progression in IDS.

Summary/Conclusion:

Physiotherapy was deemed to be beneficial with IDS patients. A longer term follow-up is needed for younger children (than the 35 month period in this study). There is a need for more research in this area of rehabilitation to expand the evidence base about exercise and to develop proactive intervention programs that can be used when IDS is at its early stages of development.

IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

Therapeutic exercise is a viable option for IDS patients who are identified by adolescent screening programs. Exercise in IDS has a role for outcomes other than stabilising the curvature and this role includes: increasing neuromotor control and stability of the spine, reducing the biomechanical collapse of the spine, and increasing breathing function. Soft tissue techniques (myofascial release etc.) are also being used in scoliosis programs.

These exercise interventions and soft tissue techniques are not in common use in Canada. There would need to be an education program about this emerging base of evidence. There would also need to be training programs for the exercise interventions that are described in European literature.

Plagiocephaly and infant scoliosis (a precursor to adolescent scoliosis) needs to be addressed in the clinical setting.

There are many opportunities for clinical research about scoliosis. Better quality studies are needed on exercise interventions. There are also several hypotheses about scoliosis that need to be tested (e.g. the postural influence on scoliosis).

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