



GUIDELINES

Evidence based position paper on physical and rehabilitation medicine (PRM) practice for people with spinal deformities during growth. The European PRM position (UEMS PRM Section)

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ABSTRACT

INTRODUCTION: Scoliosis and other spinal deformities involve 3-4% of the population during growth. Their so-called conservative treatment is in the field of competence of physical and rehabilitation medicine (PRM) physicians. This evidence based position paper represents the official position of the European Union through the European Union of Medical Specialists (UEMS) - PRM Section. The aim of the paper was to improve PRM specialists' professional practice for patients with spinal deformities during growth.

EVIDENCE ACQUISITION: A systematic review of the literature and a Consensus procedure with 26 recommendations by means of a Delphi method process has been performed involving the delegates of all European countries represented in the UEMS-PRM Section.

EVIDENCE SYNTHESIS: the systematic literature review is reported together with 26 recommendations coming from the Consensus Delphi procedure.

CONCLUSIONS: The professional role of PRM physicians in spinal deformities during growth is to propose a complete PRM treatment for the patients considering all the concurring diseases and pathologies, impairments, activity limitations and participation restrictions. The PRM physician's role is to coordinate the individual PRM project developed in team with other health professionals and medical specialists, in agreement with the patient and his family, according to the specific medical diagnoses.

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Key words: Scoliosis - Physical and rehabilitation medicine - Guidelines.

Introduction

The main spinal deformities during growth include scoliosis, sagittal curves changes (increased or reduced kyphosis and/or lordosis), and spondylolisis-

thesis.¹ They involve 3-4% of the population during growth.^{1,2} They can be secondary to another pathology (neurological, syndromic, congenital bone malformation, and others).^{2,3} The so-called conservative treatment (rehabilitation and orthopedic not surgical) are in

the field of competence of physical and rehabilitation medicine (PRM) physicians. This is even more true in patients with pathologies that give rise to a secondary spinal deformity, that are usually followed-up by PRM specialists during growth. Nowadays there is no uniformity among different countries across Europe and in the world in the PRM approach.⁴⁻⁶ For these reasons the European Union of Medical Specialists (UEMS) - PRM Section decided to develop one of its evidence based position papers, representing the official position of the European Union. The aim of the paper was to improve PRM specialists' professional practice for patients with spinal deformities during growth.

Evidence acquisition

This paper has been developed according to the Methodology defined by the Professional Practice Committee of the UEMS-PRM Section.⁷ The systematic review of the literature has been performed in PubMed the 24th of November 2014. The string used for the first selection has been “(“scoliosis”[MeSH Terms]) OR (“kyphosis”[MeSH Terms]) OR (“spondylolisthesis”[MeSH Terms])”, activating the filters: “Filters activated: Systematic Reviews, Meta-Analysis, Randomized Controlled Trial, Child: birth-18 years”. The selection process is reported in the Supplementary Figure 1, online content only. The only criterion for including the studies has been the professional relevance for PRM physicians as judged by at least two of the authors, with the main author resolving conflicts. The strength of evidence (SoE) and the strength of recommendation (SoR) are given according to the methodology paper. The Consensus with Delphi procedure has followed the 4 steps proposed by the methodology paper.⁷

Evidence synthesis

Systematic review

All paper found in the systematic review are listed in the Supplementary Appendix I, online content only.

The professional role of the PRM physician in the diagnosis and assessment of patients with idiopathic deformities during growth as a member of a multiprofessional working-group is essential.⁸ Historically, these pathologies have been followed mainly by orthopedic

surgeons, but the evolution of that specialty toward surgery reduced the attention to the so called conservative treatment.⁴ In 2004 started an international effort of the conservative community that gave rise to a new scientific society, SOSORT (international Society On Scoliosis Orthopedic and Rehabilitation Treatment), whose name clearly states the importance of PRM in this field. Moreover, treatment of spinal deformities during growth is based on a team approach,^{9, 10} and most of the allied professionals involved are in the field of PRM: physiotherapists and orthotists mainly, but also psychologist and, according to the country, chiropractors, trainers etc.^{10, 11}

The goal of PRM physicians should be in the diagnosis, prognosis, treatment and management of the team, including patients and parents.⁸ They should accurately determine which curves are at risk of worsening and which of these can be influenced by treatment, versus those curves that are at high risk of requiring surgery. Today possible treatments include:¹¹

- physiotherapeutic scoliosis-specific exercises (PSSE);
- bracing;
- surgery.

It is today accepted that these treatments are not alternative one to the other, but complimentary and have to be offered to different patients, or to the same patient in different moments.¹¹ The alternative used for years in some countries, the so-called “wait and see” strategy (*i.e.*, observation and eventual surgery), has now been mostly abandoned due to the new strong evidence on the effectiveness of braces.^{5, 12} Electrostimulation, traction and manual therapy have also been used, but there is no evidence of the effectiveness of those methods.¹¹ Once accepted that evidence-based clinical practice comes from the best evidence, combined with clinical expertise and patient preferences,^{13, 14} the patient should be made aware of the possible options. The final choice should come from a multidisciplinary shared decision making discussion, because both surgery and bracing require specific clinical expertise.

Most of the papers we found focus on adolescent idiopathic scoliosis (Supplementary Appendix I), with one exception on secondary scoliosis,¹⁵ two on kyphosis^{16, 17} and one on spondylolisthesis.¹⁸ Consequently research in these understudied fields is to be supported.

BRACING

Scientific evidence support bracing, but even if all good quality papers are in favor, the epidemiological quality of evidence is low.^{1, 5, 12} Historically two kind of braces have been used to curb progression of the pathological curves: the rigid spinal orthosis and the elastic orthosis.^{1, 5} One RCT showed the efficacy of rigid,¹² and another of elastic bracing over natural history;¹¹ another demonstrated that rigid braces are more effective than elastic ones.¹⁹ A new super-rigid generation of braces has been developed, with promising results also in high degree surgical curves.²⁰ Nevertheless there is no evidence in favor of any particular rigid brace over another.⁵ Brace treatment for adolescent idiopathic scoliosis continues to be frequently used, and the number of brace types has increased. Predicting progressive curves and refining indications requires additional investigation. Choosing the best possible intervention for each patient demands good knowledge of the alternatives and discussion about the possible effects that can be reached. In-depth discussion with the patient and possibly with the family is unconditional. Also very important is to follow up the benefit of the intervention and to identify the need of change of intervention, especially the need of surgery in case of worsening of the situation.

PSSE

The aim of PSSE is to affect Cobb angles and also secondary outcomes, such as strength, mobility, and balance.^{6, 21} The present evidence is enough to consider PSSE as an appropriate intervention for AIS, even if it is not possible to support a specific exercise regimen.^{6, 21} Experts²² and two good quality prospective studies²³⁻²⁵ support the importance of Scoliosis-Specific Exercises based on autocorrection. Nevertheless, we presently do not know which approach is more effective between inpatient or outpatient, intrinsic or extrinsic autocorrection exercise, and symmetric or asymmetric exercise. Three RCTs showed effectiveness of PSSE at 6 months^{26, 27} and at the end of growth.^{24, 25} Other studies have confirmed the efficacy of exercises in reducing the progression rate (mainly in early puberty) and/or improving the Cobb angles (around the end of growth).²⁸⁻³¹ Exercises have been shown to be effective in reducing brace prescription.²³

SURGERY

No strong evidence has been found in terms of prospective controlled studies to support surgical intervention from the medical point of view,^{32, 33} even if the methodological and ethical difficulty to perform these studies must be recognized. Surgery has been defined as the failure of conservative treatment,³⁴ meaning that it should be applied only when everything before fails: in fact it creates a problem (loss of movement function due to fusion of the spine) to avoid another one (progression of the curve). Actual indications during growth include very high degree curves (mainly secondary) with possible impact on cardiorespiratory functions, and cosmetic reasons, only if the patient and the family agree.

Recommendations

The results of the Consensus procedure are reported in Supplementary Tables I, II, online content only.

Overall general recommendation

1. The professional role of PRM physicians in spinal deformities during growth is to propose a complete PRM treatment for the patients considering all concurring diseases and pathologies, impairments, activity limitations and participation restrictions. The PRM physician's role is to coordinate the individual PRM project developed in team with other health professionals and medical specialists, in agreement with the patient and family, according to the specific medical diagnoses. (SoE: IV; SoR: A)

Idiopathic spinal deformities

Recommendations on PRM physicians' role in medical diagnosis according to ICD

2. It is recommended that PRM physicians dealing with spinal deformities gain specific and wide expertise in the specific medical diagnosis and treatment approaches of these patients. If this is not possible, they should work in team with spinal deformities experts of other specialties to develop the required PRM treatments. (SoE: IV; SoR: B)
3. It is recommended that PRM physicians start the PRM process with a definite expert medical diagnosis of the spinal deformity. (SoE: IV; SoR: B)

Recommendations on PRM physicians' role in PRM diagnosis according to ICF

4. It is recommended that spinal deformities patients requiring a PRM intervention (so-called conservative treatment: mainly bracing and/or exercises) are evaluated by PRM physicians to diagnose their impairments, activity limitations and participation restrictions so to better focus a complete PRM approach. (SoE: IV; SoR: A)

Recommendations on PRM physicians' role in PRM assessment according to ICF

5. It is recommended that PRM treatment is proposed and regularly monitored through a complete PRM assessment including evaluation of disease and impairment (classical radiographic and clinical parameters), but also activity limitations and participation restrictions due to health condition and/or treatments. (SoE: IV; SoR: B)

Recommendations on PRM management and process

INCLUSION CRITERIA (E.G. WHEN AND WHY PRESCRIBE PRM INTERVENTIONS)

6. It is recommended that PRM interventions are proposed to spinal deformity patients with an actual impairment, activity limitation or participation restriction, or with a possible or proven progression that could drive to a future activity limitation or participation restriction in adulthood. (SoE: IV; SoR: A)

PROJECT DEFINITION (DEFINITION OF THE OVERALL AIMS AND STRATEGY OF PRM INTERVENTIONS)

7. It is recommended that the PRM projects are proposed in PRM centres specialised in spinal deformities treatment where all the team is present (PRM doctor, physiotherapist, orthotist, trainer, eventually psychologist and others) and an adequate expertise is granted to patients (PRM structure project). (SoE: IV; SoR: B)
8. It is recommended that the project is defined on a totally individualised basis in agreement with patient and family. (SoE: IV; SoR: A)

TEAM WORK (PROFESSIONALS INVOLVED AND SPECIFIC MODALITIES OF TEAM WORK)

9. It is recommended that a coordinated and organized team follow the patient, including at least a PRM physician, a medical specialist expert in spinal deformities (usually an orthopaedic surgeon, or another PRM physician consultant) in case the PRM physician has not a specific expertise, an orthotist, and a physiotherapist. The patient and his family are part of the team. For the possible surgical choices, an orthopaedic surgeon must be part of the team as well. (SoE: IV; SoR: B)

PRM INTERVENTIONS

10. It is recommended that PRM interventions are developed according to the actual Guidelines produced by the international Society On Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT),¹ including mainly specific exercises and/or bracing, as well as recommendations on activities of daily living. (SoE: IV; SoR: A)

OUTCOME CRITERIA

11. It is recommended to use the classical main outcome criteria, including Cobb degrees thresholds as described in the literature, aesthetics and overall spinal balance on the frontal and sagittal plane. It is recommended that also patient-centred outcomes (quality of life, activity limitations, participation restrictions, impact of treatments) are monitored regularly together with the usual impairment and disease-centred parameters. (SoE: IV; SoR: B)

LENGTH/DURATION/INTENSITY OF TREATMENT (OVERALL PRACTICAL PRM APPROACH)

12. It is recommended that treatment (bracing and/or exercises according to the actual SOSORT Guidelines) is continued until the impairments (pain, aesthetic impact...) are resolved and/or the risk of progression is finished (enough bone maturity according to the quantity of deformity), so to grant to the patient the best possible future in terms of activity and participation according to the actual prognostic instruments. (SoE: IV; SoR: A)

DISCHARGE CRITERIA (E.G. WHEN AND WHY END PRM INTERVENTIONS)

13. It is recommended that patients are followed up until any further progression of the deformity is not expected anymore (stabilization) and/or impairments (pain, aesthetic impact...) have been resolved as far as possible. (SoE: IV; SoR: A)

Recommendations on future research on PRM professional practice

14. It is recommended to develop ICF compatible evaluation instruments for spinal deformities during growth. (SoE: IV; SoR: B)

Secondary spinal deformities

Literature search yielded a few research related with Secondary Deformities. So most of the recommendations in Secondary Spinal Deformities are based on evidence extrapolated from Evidence, Research and Recommendations of Idiopathic Spinal deformities and is therefore supported by expert opinion in Secondary Spinal Deformities.

Recommendations on PRM physicians' role in Medical Diagnosis according to ICD

15. It is recommended that PRM physicians dealing with pathologies that can give rise to secondary spinal deformities monitor regularly patients to immediately screen any spinal pathology. (SoE: IV; SoR: A)
16. It is recommended that PRM physicians dealing with pathologies that can give rise to secondary spinal deformities gain specific expertise also in the diagnosis of spinal secondary disorders and treatment approached to integrate them in the overall approach to the main pathology. If this is not possible, they should work in team with another medical specialist expert in secondary spinal deformities (usually an orthopaedic surgeon or a neurosurgeon) to develop the required PRM treatments. (SoE: IV; SoR: A)
17. It is recommended that PRM physicians dealing with pathologies that can give rise to secondary spinal deformities plan the PRM process approaching also the spinal deformity eventually present according to a definite expert medical diagnosis. (SoE: IV; SoR: A)

Recommendations on PRM physicians' role in PRM diagnosis according to ICF

18. It is recommended that patients with secondary spinal deformities requiring a PRM intervention are evaluated by PRM physicians to diagnose their impairments, activity limitations and participation restrictions so as to have a complete PRM approach. (SoE: IV; SoR: A)

Recommendations on PRM physicians' role in PRM assessment according to ICF

19. It is recommended that, before and during PRM treatment of patients with secondary spinal deformities, the PRM assessment includes the evaluation of the spinal disease and impairment (classical radiographic and clinical parameters) together with those of the main pathology. (SoE: IV; SoR: A)

Recommendations on PRM management and process

INCLUSION CRITERIA (E.G. WHEN AND WHY PRESCRIBE PRM INTERVENTIONS)

20. It is recommended that PRM interventions include an approach to the spinal deformity as soon as it is discovered, due to the high risk of progression, possibly leading with time to a big impairment of trunk statics (and consequently gait and/or posture) and even cardiopulmonary dysfunctions. (SoE: IV; SoR: A)

PROJECT DEFINITION (DEFINITION OF THE OVERALL AIMS AND STRATEGY OF PRM INTERVENTIONS)

21. It is recommended that, in case of spinal deformities, the PRM projects include also specific treatments of the spine (such as bracing, and/or exercises to improve spinal posture and control) according to individual needs. (SoE: IV; SoR: A)

TEAM WORK (PROFESSIONALS INVOLVED AND SPECIFIC MODALITIES OF TEAM WORK)

22. It is recommended that a coordinated and organized team follow the patient, including at least: a PRM physician; a medical specialist expert in spinal de-

formities in case the PRM physician is not an expert (usually an orthopaedic surgeon, a neurosurgeon, or another PRM physician consultant); an expert in the original pathology (*e.g.* paediatrician, neuropaediatrician, neurologist, syndromes expert, orthopaedic surgeon, neurosurgeon etc) causing the spinal deformity; an orthotist; a physiotherapist. The patient and his family are part of the team. (SoE: IV; SoR: B)

PRM INTERVENTIONS, OUTCOME CRITERIA AND OVERALL PRACTICAL PRM APPROACH

23. It is recommended that PRM interventions are developed according to the actual Guidelines produced by the international Society On Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT),¹ including mainly specific exercises and/or bracing, as well as recommendations on activities of daily living, but they have to be modified according to the underlying cause of secondary spinal deformity. (SoE: IV; SoR: A)

DISCHARGE CRITERIA (*E.G.* WHEN AND WHY TO END PRM INTERVENTIONS)

24. It is recommended that patients with secondary spinal deformities are followed up until any further progression of the deformity is not expected anymore (stabilization). (SoE: IV; SoR: B)

Recommendations on future research on PRM professional practice

25. It is recommended to start systematic research on the epidemiology of secondary spinal deformities and possible conservative rehabilitation approach to patients with secondary spinal deformities during growth. (SoE: IV; SoR: B)

26. It is recommended to start a systematic research to identify the best PRM interventions, their length/duration/intensity, and the correct outcome criteria for secondary spinal deformities during growth. (SoE: IV; SoR: B)

Conclusions

The professional role of PRM physicians in spinal deformities during growth is to propose a complete PRM

treatment for patients considering all the concurring diseases and pathologies, impairments, activity limitations and participation restrictions. The PRM physician's role is to coordinate the individual PRM projects developed in team with other health professionals and medical specialists, in agreement with the patient and family, according to the specific medical diagnoses.

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For supplementary materials, please see the online version of this article.

SUPPLEMENTARY MATERIALS

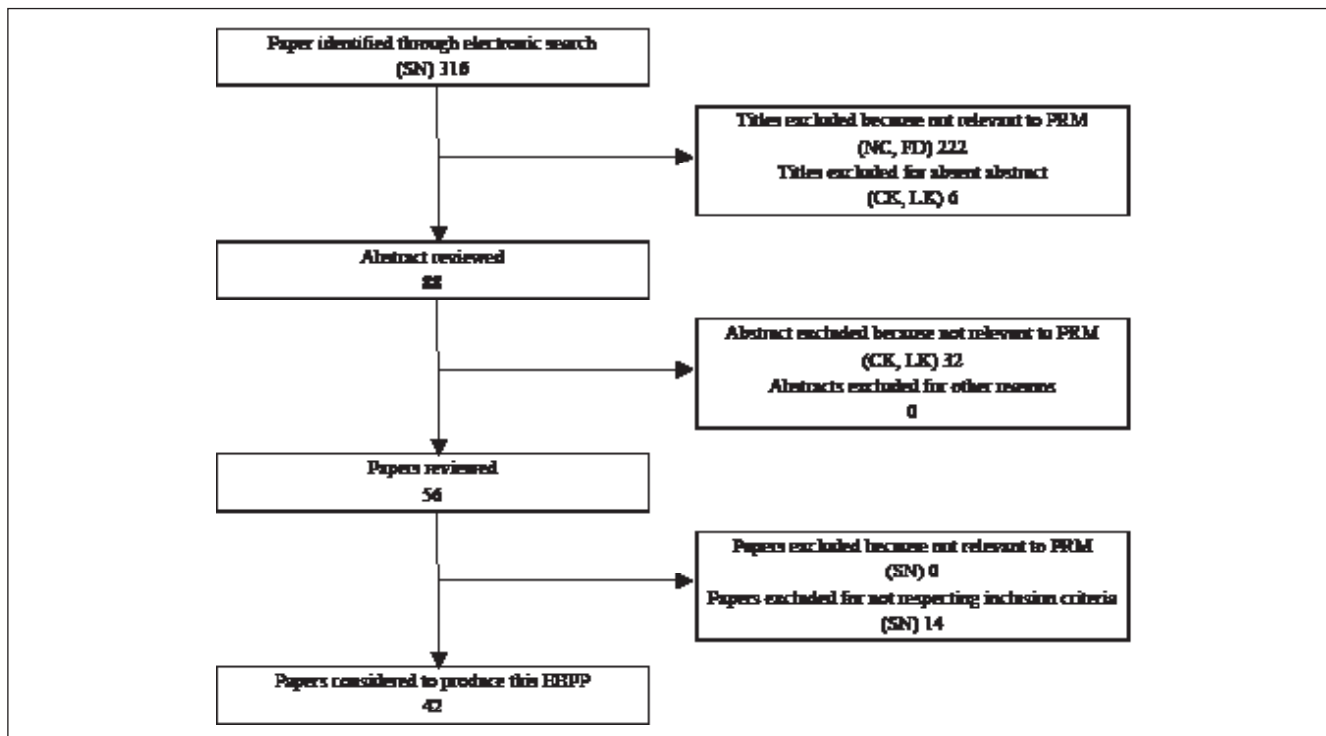
Supplementary Appendix I.—Paper found with the systematic review

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Supplementary Figure 1.—Flow Chart of papers selection.

SUPPLEMENTARY TABLE I.—Results of the Consensus procedure.

| Round | Number of recommendations | Accept | Accept with suggestions | Reject |
|-------|---------------------------|--------|-------------------------|--------|
| 1 | 26 | 57.7% | 42.3% | 0 |
| 2 | 26 | 92.3% | 7.7% | 0 |
| 3 | 26 | 100% | 0 | 0 |
| 4 | 26 | 100% | 0 | 0 |

SUPPLEMENTARY TABLE II.—Overall view of the recommendations.

| Content | Number of recommendations Number | Strength of Recommendations | | | | Strength of Evidence | | | |
|---|-------------------------------------|-----------------------------|-------|---|---|----------------------|----|-----|------|
| | | A | B | C | D | I | II | III | IV |
| Overall recommendation | 1 | 100% | 0 | 0 | 0 | 0 | 0 | 0 | 100% |
| PRM physicians' role in medical diagnosis - ICD | 5 | 60% | 40% | 0 | 0 | 0 | 0 | 0 | 100% |
| PRM diagnosis and assessment- ICF | 4 | 75% | 25% | 0 | 0 | 0 | 0 | 0 | 100% |
| PRM management and process | 13 | 61.5% | 38.5% | 0 | 0 | 0 | 0 | 0 | 100% |
| Future research on PRM professional practice | 3 | 0 | 100% | 0 | 0 | 0 | 0 | 0 | 100% |
| Total | 26 | 57.7% | 42.3% | 0 | 0 | 0 | 0 | 0 | 100% |

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