SOSORT AWARD NOMINEES GROUP TWO

SPLITTING GROWTH INTO 3 PHASES WITH CUT-OFFS AT PUBERTAL SPURT AND RISSER 3 FACILITATES PREDICTION OF PROGRESSION. A STUDY OF NATURAL HISTORY OF IDIOPATHIC SCOLIOSIS PATIENTS FROM AGE 6 TO END OF GROWTH

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Introduction

We developed a model to predict the curve progression in patients with idiopathic scoliosis starting from a dataset including 2317 previously untreated patients from age 6 to 25. We were able to predict only 55% of the observed values with adequate precision. Consequently, we decided to move to another data analysis, starting from Duval—Beaupère papers, which recognized 3 phases of progression: one up to the start of puberty, a second from puberty to Risser 3 and a third from Risser 3 to the end of growth.

Research Question

Are three age-specific prediction models able to predict idiopathic scoliosis evolution better than an overall model spanning from age 6 to the end of growth?

Methods

We tried two strategies to divide the age groups. Strategy 1. We searched the exact timing of the start of growth (Point P). We searched all patients with radiographs with Risser 1 stage (after point P) and one or more previous consultations with radiographs while untreated. We hypothesized point P (sudden height growth) as a consultation with 1 standard deviation above average pubertal growth and looked for the time distance (months) from Risser 1. Strategy 2. We looked at the percentage of patients who reached Risser 1 in the different age groups.

We considered the following variables: Cobb angle at the baseline, time (squared and cubic too), Risser score, sex. A linear mixed-effect model analysis with random effects (SAS procedure MIXED) and maximum likelihood estimate was used to examine the effect of the different candidate variables on maximum Cobb angle accounting for repeated measures from the same patient. The data set was divided into subgroups for multiple-fold cross-validation.

Results

Strategy 1 failed. With strategy 2 we found 1.3% Risser 1 up to age 9, 3.2% up to 10 and 10.2% up to 11. Consequently, we set the cut-off at age 11.

The prediction models we found were:

- A (up to age 10, n.342): 1.64 +1.09 Cobb +0.82 time (years) +0.73 time2 –0.08 time3
- B females (age 11 to Risser 2, n.916): –1.01 –1.85 (Risser 1) –2.53 (Risser 2) +1.12 Cobb +6.88 time -1.81 time2 +0.35 time3
- C (Risser 3 to end of growth, n.469): 1.44 –2.04 (Risser 4) –1.44 (female) +1.03 Cobb +1.71 time –0.14 time2

The cross-validation results for the percentage of observed values falling within the prediction interval ±5° were 63.9-76.9% for A, 61.1-71.3% for B-females and 85.9-88.2% for C.

Conclusions

The preliminary results of a model based on 3 ages show better prediction than an overall model including all these ages.

Discussion

Our results are promising and confirm that the pubertal period is the most difficult for prediction. Prognosis is a crucial part of idiopathic scoliosis evaluation and the development of accurate prediction models coming from natural history data is of great importance. This work is still in progress, but results will offer clinicians new tools to be used to decide on treatment together with patients, within a shared-decision making model of care.

Disclosures (any Conflicts of Interest)

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Group A		Coefficient estimate	95% CI for the estimate		p-value
			Lower limit	Upper limit	
Intercept		1.64	-2.69	5.98	0.46
Max Cobb angle at baseline		1.09	0.98	1.21	<0.0001
Difference in age (age at the observation – age at the baseline, in years)		0.82	-5.05	6.70	0.78
Difference in age^2		0.73	-1.89	3.35	0.58
Difference in age^3		-0.08	-0.41	0.25	0.62
Group B - females		**Coefficient estimate**	**95% CI for the estimate**		**p-value**
			Lower limit	Upper limit	
Intercept		-1.01	-3.64	1.62	0.45
Max Cobb angle at baseline		1.12	1.07	1.16	<0.0001
Difference in age (age at the observation – age at the baseline, in years)		6.88	1.93	11.83	0.007
Difference in age^2		-1.81	-4.89	1.26	0.25
Difference in age^3		0.35	-0.20	0.89	0.21
Risser grade at baseline	1 vs 0	-1.85	-3.33	-0.37	0.01
	2 vs 0	-2.53	-5.01	-0.07	0.045
Group C		**Coefficient estimate**	**95% CI for the estimate**		**p-value**
			Lower limit	Upper limit	
Intercept		1.44	-0.37	3.25	0.1181
Max Cobb angle at baseline		1.03	0.99	1.07	<0.0001
Difference in age (age at the observation – age at the baseline, in years)		1.78	1.07	2.50	<0.0001
Sex (Female vs Male)		-1.44	-2.73	-0.14	0.0300
Risser grade at the baseline (4 vs 3)		-2.04	-3.23	-0.86	0.0008
Difference in age^2		-0.14	-0.24	-0.036	0.0083