

Letter Re: A clinical prediction model to assess surgical outcome in patients with cervical spondylotic myelopathy: internal and external validations using the prospective multicenter AOSpine North American and international datasets of 743 patients. *The Spine Journal* 2015; 15: 388-397.

Evaluating a prediction model using a separate dataset from which the model was developed is a crucial step in assessing its predictive performance, often referred to as external validation [1]. The recent study by Tetrault and colleagues modified their previous prediction model [2] by omitting one of the predictors and then re-fitting the model on the original development data from 12 sites from North America [3]. The modified prediction model was subsequently evaluated on a larger international cohort from the AOSpine CSM-I trial [4]. Whilst it is encouraging to see authors carrying out such external validation studies, there are concerns in the analysis which need highlighting.

It is widely accepted that the two main characteristics to report when evaluating the performance of a prediction model are discrimination and calibration [5]. In the study by Tetrault et al [1], calibration has been incorrectly evaluated. The authors have presented the traditional and commonly seen plot of predictions and observed outcomes, by ranking and grouping individuals (47 groups of size 10), and calculating the mean observed outcome against the mean predicted probability. However, the authors have then incorrectly fit a linear regression line to the 47 points and examined whether the resulting intercept and slope are noticeably different from 0 and 1 respectively. The arbitrary creation of groups of size 10 will affect these estimates of the slope and intercept, and different values will result if groups of 5 or 20 were made. The correct approach would be to calculate the slope and intercept fitting the linear predictor ($LP = 1.59 - 0.81P + 0.19mJOA + 0.91IG - 0.69S - 0.27DS$) calculated for all individuals in the validation dataset as the only predictor in a logistic regression model: $\log \text{ odds (outcome)} = \alpha + \beta \times \text{linear predictor}$ [6].

A second concern is that the authors re-fit the model on the validation dataset and then made a judgment on the similarity of the regression coefficients. This does not constitute an assessment of validation and provides no useable information on the performance of the prediction model [6]. Validation concerns only evaluating the performance of the prediction model in new data.

The Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis (TRIPOD) Initiative (www.tripod-statement.org) recently published the TRIPOD reporting guideline for clinical prediction models, where key issues in the development and validation of a prediction model are discussed. The TRIPOD guideline is similar to other well-known reporting guidelines (e.g. CONSORT, STROBE, PRISMA) designed to help authors, peer reviews and journal editors in ensuring that the essential items describing the development or validation of a clinical prediction model are clearly reported [5]. Accompanying the reporting guideline is an extensive Explanation & Elaboration article describing the rationale for the checklist item but also highlighting many methodological considerations when developing or validating a clinical prediction model [6].

REFERENCES

1. Altman DG, Vergouwe Y, Royston P, Moons KGM. Prognosis and prognostic research: Validating a prognostic model. *BMJ*. 2009;338:b605.
2. Tetreault LA, Kopjar B, Vaccaro A, et al. A clinical prediction model to determine outcomes in patients with cervical spondylotic myelopathy undergoing surgical treatment: data from the prospective, multi-center AOSpine North America study. *J Bone Joint Surg Am*. 2013;95(18):1659-66.
3. Tetreault LA, Cote P, Kopjar B, et al. A clinical prediction model to assess surgical outcome in patients with cervical spondylotic myelopathy: internal and external validations using the prospective multicenter AOSpine North American and international datasets of 743 patients. *The spine journal : official journal of the North American Spine Society*. 2015;15(3):388-97.
4. Fehlings M, Kopjar B, Defino H, Barbagallo G, Arnold P, Zileli M. International variations in the clinical presentation and management of cervical spondylotic myelopathy: one year outcomes of the AOSpine multicenter prospective CSM-I study. *The spine journal : official journal of the North American Spine Society*. 2013;13:S20-S1.
5. Collins GS, Reitsma JB, Altman DG, Moons KGM. Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD): The TRIPOD Statement. *Annals of Internal Medicine*. 2015;162(1):55-63.
6. Moons KGM, Altman DG, Reitsma JB, et al. Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD): Explanation and Elaboration. *Annals of Internal Medicine*. 2015;162(1):W1-W73.