Answer to the comment by Dietrich Schlenzka on “A proposal for a surgical classification of pediatric lumbosacral spondylolisthesis based on current literature (J.-M. Mac-Thiong, H. Labelle)”

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We wish to thank Dr. Schlenzka for his judicious comments. We completely agree with him that the scientific evidence is currently too sparse to provide definitive recommendations concerning the surgical treatment of pediatric lumbosacral spondylolisthesis. The rationale of our study was in fact directly focused on this specific problem. After a thorough review of the literature and from the recent findings on spino-pelvic balance, we concluded that one of the main impediments to reaching a consensus on the treatment of this disorder was the failure to recognize that the slip grade in only one component of the deformity. As a primary objective of our article, the proposed classification suggests that subjects with spondylolisthesis are a heterogeneous group and that clinicians need to keep this fact in mind for evaluation and treatment. As noted many times in the article, the tentative algorithm presented was not meant to be considered as the final scheme of treatment but rather was provided to illustrate and better support the notion that spondylolisthesis involves a heterogeneous group of subjects and that consequently the treatment should not be the same for all patients. We strongly believe that the development of a comprehensive classification is a prerequisite and a *sine qua none* for future studies in order to end up with strong recommendation on the treatment of the different types of spondylolisthesis.

It is exact that we based our classification on the premise that the complexity of the surgery should increase as the severity of spondylolisthesis increases. Although it seems axiomatic, we agree with the Dr. Schlenzka that it “is not necessarily true for a chronic condition” and that it is still to be proven. However, we believe that it is in fact true (at least when considering the slip grade) since in the current literature, there is sufficient evidence supporting that the “gold standard” in situ fusion for low-grade spondylolisthesis is not appropriate for all patients with severe high-grade spondylolisthesis. There is also some evidence from Molinari et al. that posterior element dysplasia (size of transverse processes) influences the planning of surgical treatment in high-grade spondylolisthesis. While the current tendency is towards more complex surgery for high-grade slips—most authors now recommend partial reduction with circumferential fusion and some form of pelvic stabilization—we wanted to underline that a complex surgery may not be necessary for all patients. In the meantime, the Spinal Deformity Study Group (SDSG) is currently enrolling a prospective multi-center cohort of patients surgically treated for spondylolisthesis and we hope that this large database will allow to verify the relevance of the proposed classification in predicting the outcome with respect to all types of surgery.

Concerning the criteria to differentiate between low- and high-dysplastic slips, we totally agree with Dr. Schlenzka that there is currently insufficient data to adequately characterize dysplasia. This is an important question that definitely needs to be addressed. This is why the SDSG is now conducting studies to establish standards to quantify dysplasia in spondylolisthesis. For example, a recent study by the SDSG has shown that significant sacral doming, as assessed by a group of spinal surgeons, occurs when the

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dome height measures more than 25% of the length of the upper sacral endplate.

As pointed out by Dr. Schlenzka and already cited in the article, patient's age is an important criterion that needs to be taken into consideration for surgical planning. However, an age-based criterion was too difficult to incorporate into the classification due to the lack of data in the literature. This is why we mentioned in the article that age should be considered on an individual basis. It is also true that radiation exposure is an important aspect that needs to be considered. As surgeons usually follow up spondylolisthesis using lumbosacral films, we believe that standing long films are necessary in the preoperative work-up. The addition of a single long film preoperatively is not related with undue radiation, considering also that patients often have scoliosis and that assessing spinal balance is

important. Regarding CT scans, we agree that they are not mandatory (as already mentioned in the text), especially if an MRI is available. In addition, in our current practice, we have found that plain films are sufficient to classify spondylolisthesis with an acceptable intra- and inter-rater reliability.

Finally, as mentioned many times in the article, the algorithm presented was only a proposal meant to illustrate the foreseen clinical use of the classification. Further research is required before reaching our ultimate goal of proposing a definitive surgical algorithm for lumbosacral spondylolisthesis. Although this is only the beginning of a long road, we believe the proposed classification can serve as the starting point for future studies that will provide evidence-based data concerning the progression and treatment of lumbosacral spondylolisthesis.