Improvement of Posterior Wedge Osteotomy Programation Using the 3D EOS Imaging System in Standing Position: Femur Angulation and Knee Flexion Are Important to Analyze. F.B.I. Technique
J.-C. Le Huec¹, S. Aunoble¹, P. Leijssen¹, M. Duarte¹, J. Rigal¹
¹Spine Unit Department - Bordeaux University Hospital, Bordeaux, France

Purpose: Using the new 3D radiograph EOS imaging system it is possible to have a global analysis of the sagittal balance. The hip and knee flexion can be analyzed.

Study design: Prospective study.
To determine the osteotomy angle in patients with severe lumbar kyphosis, it was decided to consider the hip flexum in the calculation. The angle of femur angulation with the vertical line was added to the angle of osteotomy.

Material and method: 25 patients have been operated for important sagittal imbalance problem. The lumbar lordosis was negative with a minus 9 degrees. The average hip flexum was 24,2 degrees. The average spino sacral angle (SSA) was 104,5° (normal is 130° ± 7,3). The compensatory attitude with knee flexion is standing position was always reducible. A posterior wedge osteotomy using he egg shell technique was performed with pedicular based fixation from S1 to T10 or higher if needed. An additional inter-pedicular osteotomy was performed two levels above in case an additional correction was requested according to the pre-op planning. Motor and somesthesic evoked potential were used for all patients. Post op evaluation was performed using the same 3D EOS imaging system with evaluation of the same parameters.

Results: Surgeries were performed without major complications. No paraplegia, one sciatic pain L5 in two patients, one hematoma resolved spontaneously, one delayed deep infection that resolved with surgical cleaning and antibiotics for 3 months. The average osteotomy angle was 29,4 degrees (23,5° to 42°). The level of osteotomy was : L4 : 16 cases, L3 : 3 cases, L2 : 1 case. The pre op C7 plumb line was located 6,6 cm in the front of femoral head and was behind it in all cases at an average of 2,3 cm post operatively. The SSA increased from 104,5° to 124,3°.The pelvis tilt was dramatically increased in all patients, from minus 4,3° to 12,1° (incidence angle was constant). The lumbar lordosis was positive (average 28,8°) demonstrating the importance of the correction. The osteotomy angle planning was increased to pay attention to the femur angulation (reflecting the knee flexion) (18,2° on average). The osteotomy correction was determined on the sagittal plan of the spine in standing position. The pre-operative planning osteotomy to perform was: 28,8° + 18,2° = 47°. On the final result the corrected angle was at an average of 37,4 degrees which is lower than expected to obtain an ideal balance but sufficient to rebalance the spine as demonstrated by the position of post C7 plumb line at the level of the S1 plateau behind the femoral head. In the light of this experience we propose a new calculation method named FBI for « full balance integrated » to determine the best correction needed : the position of the C7 plumb line related to the osteotomy level and the importance of the femur angulation with the vertical reflecting the knee flexion are directly included in the calculation.

Conclusions: To obtain a good sagittal alignment in patient with lumbar kyphosis needing a posterior wedge osteotomy, the knee flexion parameter to consider to avoid undercorrection and obtain a good sagittal spine balance.