3D-Print Template-Supported Navigation for Correction of Intra-Articular Deformities

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Purpose: Intra-articular deformities are difficult to treat and most of them will end in arthroplasty. With the increased access to 3-dimensional (3D) printed tools, patient-specific templates can be generated in order to improve orientation and allow navigation of various cutting and reduction tools during corrective osteotomies.

Methods: There are several critical steps included: (1) clinical examination, (2) bilateral 3D CT scans, (3) transfer of DICOM (Digital Imaging and Communications in Medicine) into STL files, (4) these STL files represent 3D datasets that can be analyzed (alignment) and manipulated (mirrored and compared to contralateral side, virtual osteotomy, and virtual reduction, and (5) virtual construction of tools with complementary shapes to bone surface. These tools can made for various purposes, mainly osteotomy guides and reduction templates. The technique is demonstrated in a 24-year-old patient with a malreduced and malunited B-type distal femur fracture. He presented 2 years after trauma with a visual analog scale score between 6 and 8, limping, and varus deformity. 3D-printed proximal and distal master blocks are fixed to the bone using screw holes from previous surgeries as reference. The osteotomy itself, but also the reduction, is controlled with templates.

Results: Comparison between bilateral pre- and postoperative CT scans in overlay technique (Fig. 1) shows precise correction within 2 mm and 3° of deformation in a series of 4 cases.

Conclusion: The treatment of intra-articular deformities with 3D-print template-supported navigation can improve orientation in the operating field and increase precision of surgical correction. However, time-consuming planning is needed due to a complex segmentation process.