Category: Knee - Ligaments (Not ACL)

3D Printing Technology is a More Accurate Tool Than the Skill of an Experienced Surgeon to Reproduce Femoral Bone Tunnels In Multi-Ligament Knee Injuries

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Summary:
A critical step in multiple-ligament knee reconstruction techniques is to avoid short tunnels or convergences among them. The use of 3D printed patient-specific instrumentation provides accurate results for the creation of these tunnels and may be a promising tool to be used in the clinical practice.

Data:
Objectives Multiple-ligament knee reconstruction techniques often involve the creation of several bone tunnels for various reconstruction grafts. A critical step in this procedure is to avoid short tunnels or convergences among them. Recent studies have recommended to drill the bone tunnels following different angulations on the coronal and axial planes to avoid any coalescence among them. The aim of the study was to compare the accuracy of 3D printed patient-specific instrumentation (PSI) with a "freehand" of an expert surgeon for drilling lateral and medial femoral tunnels following these recommended angulations in multi-ligament knee injuries. Methods Ten cadaveric knees were scanned by computed tomography (CT) to identify anatomical femoral attachments of the lateral collateral ligament (LCL) and the Popliteal Tendon (PT) at the lateral side, and the Medial Collateral Ligament (MCL) and Posterior Oblique Ligament (POL) at the medial side. Using a specific computed software, we planned four bone tunnels for each knee starting from the anatomical attachment of LCL, PT, MCL and POL applying the directions described above. Ten 3D printed surgical guides (5 medial and 5 lateral) specifically designed for five knees were used to perform LCL, PT, MCL and POL tunnels. The tunnels of the other five knees were made freehand by the experienced knee surgeon. Postoperative CT scans were made to each cadaveric knee. We assessed the accuracy of the tunnels by superimposing postoperative CT images onto preoperative ones and analyzed the deviation of performed tunnels from the planning, specifically the cortical entry point and the angular deviations. Results For all continuous data, the median was used as the measure of variance. For comparing variables among groups, we used Mann-Whitney test, with p values <0.05 counting as significant. In "freehand" group, the mean entry point deviation was 5.45mm and interquartile range (Q1-Q3) was 2.59 – 8.84mm. In "PSI" group and in PSI group the mean entry point deviation was 4.23mm and (Q1-Q3) was 3.59 – 5.73mm. In "freehand" group, the mean angular deviation (º) was 22.28º and (Q1-Q3) was 17.65 – 25.21º. In "PSI" group the mean angular deviation (º) was 5.59º and (Q1-Q3) was 4.04 – 8.25º (p value<0.001). Conclusions The use of 3D printed PSI provided significantly more accurate results relative to angular mean deviation than the skill of an experienced knee surgeon and may be a promising tool to be used in the clinical practice.