Comparison of the anatomical clavicular plate using 3D printer

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Purpose
Pre-contoured plate can be used for the clavicle fractures to avoid bending or twisting the plate during operation. Due to individual variances of the length, angulation, torsion of the clavicle, the discordance of the clavicle and pre-contoured plate happens sometimes. We made clavicle models from the DICOM files of clavicle 3D CT. Those were made using the 3D printer. We wanted to analyze the discordance of the pre-contoured plates and clavicle models.

Materials
We enrolled the 30 cases undertaking shoulder 3D-CT. The cases having clavicle fractures or any history of operation for the clavicle, were excluded. Using the ITK-SNAP software (version 3.4.0) and Meshmixer software (version 3.0), DICOM files were transformed to the 3D model files having an extension, stl. Those files were printed by the fused deposition modeling type 3D printer (da Vinci 2.0A; XYZ printing, Taiwan).

Methods
Three pre-contoured plates for the distal clavicle fracture (Acumed; Synthes; Arthrex) were used. After placing the plate on the printed 3D model, the gap and discordance were evaluated using a digital caliper.

Results
Fifteen male and 15 female were included. There was no difference of age between male and female groups. The average length of clavicles were 156.1mm (range, 138.3-167.9mm) in male and 138.4mm (range, 129.3-145.5mm). The distance between the lateral end of plate and clavicle, the gap of clavicle surface and plate showed no difference between 3 plates. However, overhang of the medial end of plate showed significant difference between male and female groups.

Conclusion
Shorter clavicle had more severe discordance of pre-contoured plates and 3D clavicle models. In the 61% of the models, the medial end of the plate were overhung more than 3mm from the clavicle.