Computerised protocol for distal femoral deformities using three-dimensional designed patient-specific guides

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INTRODUCTION

Long bone deformities are common in veterinary medicine. The majority of cases require its surgical resolution in order to correct the angular deformity. For its correction, distal femoral ostectomies (DFO) are recommended.

Is it estimated that an anatomical lateral distal femoral angle (aLDFA) bigger than 102º should be corrected and a DFO must be perfomed. Conventional DFOs lead to higher rate of human error due to its lack of standardised protocols. Thanks to 3D printing, this curse of action is about to change.

OBJECTIVE

This paper aims to review the existing literature on patient-specific intraoperative guides, and to create a surgical protocol usung 3D priting technology to demonstrate the usefulness of these guides by means of a practical example of a real clinical case of a patient with a complex distal femoral deformity.

MATERIAL & METHODS

For this project's literature research was performed in three different databases: *PubMed*, *Google Scholar* and *ScienceDirect*. Tomographic and radiographic images were obtained from a clinical case of distal femoral deformity and a non-pathological patient. Then 3D processing wass done by using computer aided design program Mimics®. Angular examination of patients femurs was conducted. The virtual planning and 3D design of PSGs and implant was perfomed with 3-Matic® software. 3D printing was done in two different 3D printers, Prusa XL and Ultimaker S5. Printing material used was polilactic acid (PLA) and polivinil acetate (PVA). DFO was perfomed used the conventional tools.

DISCUSSION

Varus deformities of distal femur are relatively frequent. Diagnosis rely on the 2D angle study of each case. Most of the literature is reduced to big breeds and measurement is limited to a correct position of the bones when the images are taken. TC images allows for a more accurate evaluation. There is no approved method in femoral varus measure. In severe deformities DFOs must be performed once the CORA is determined. Conventional DFOs are performed freehand which leads to higher risk since position, orientation and magnitude of the correction rest with surgeon's judgement. PSGs contribute to accurate consecution of the preoperative planning goals and the final clinical result. They are a single use instrument that optimises intraoperative precision by improving its safety and reliability. Customising an implant helps shortening the surgical time and assist to get the goal position of bone fragments after the DFO is performed.

One of the biggest limitations in this project is the size of the bones that we worked on since three anatomical models were life-sized and the lack of normal angle references in small breeds. Finally, the DFO was never performed in the real patient.

RESULTS
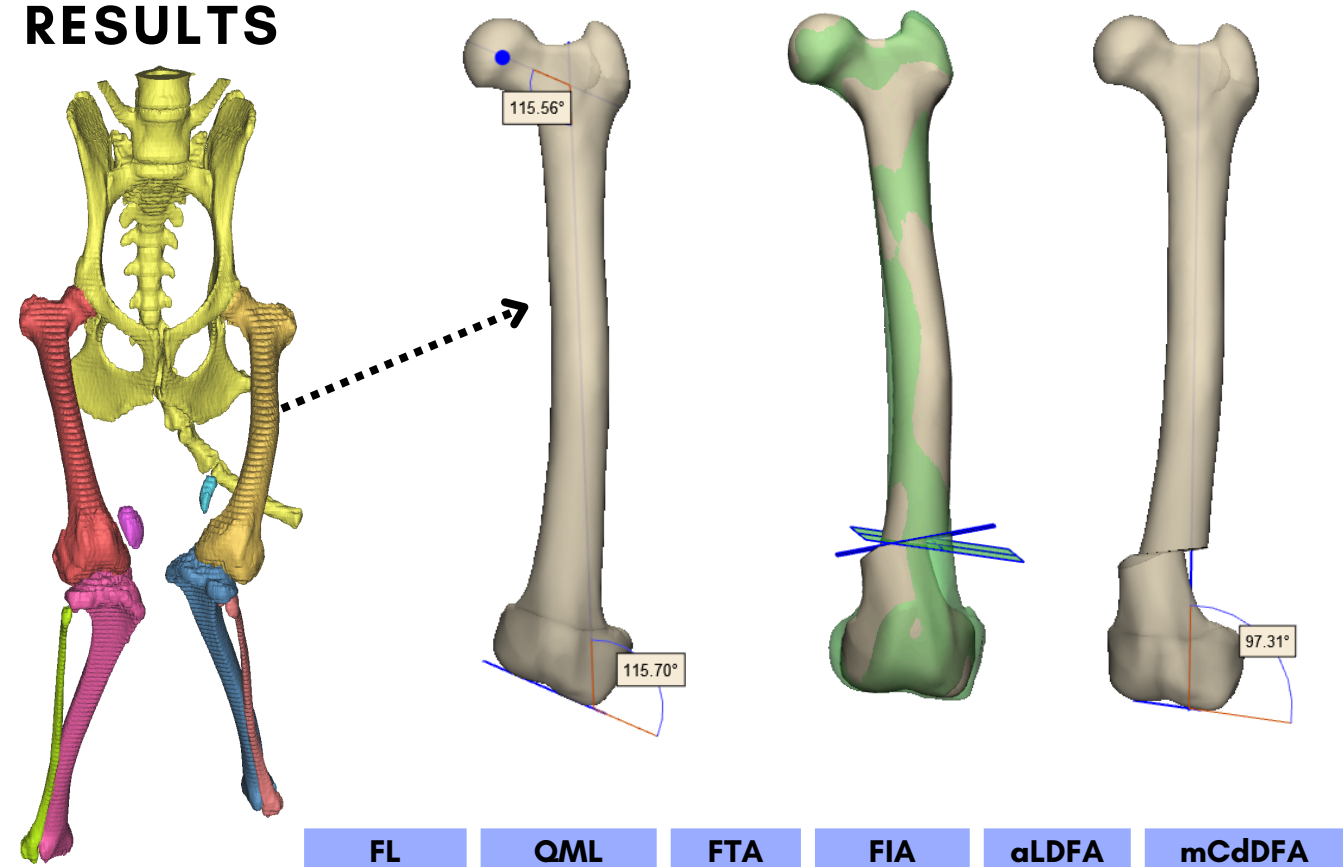
	FL	QML	FTA	FIA	aLDFA	mCdDFA
Right femur	85,94mm	63,83mm	16'50º	114'55º	96'89º	111'89º
Left femur	85,05mm	52,55mm	3'22º	115'56º	115'70º	107'82º
Reference values	-	-	19'8± 4'6	125'4±4'1	95'6±2'1	108'4±1'7
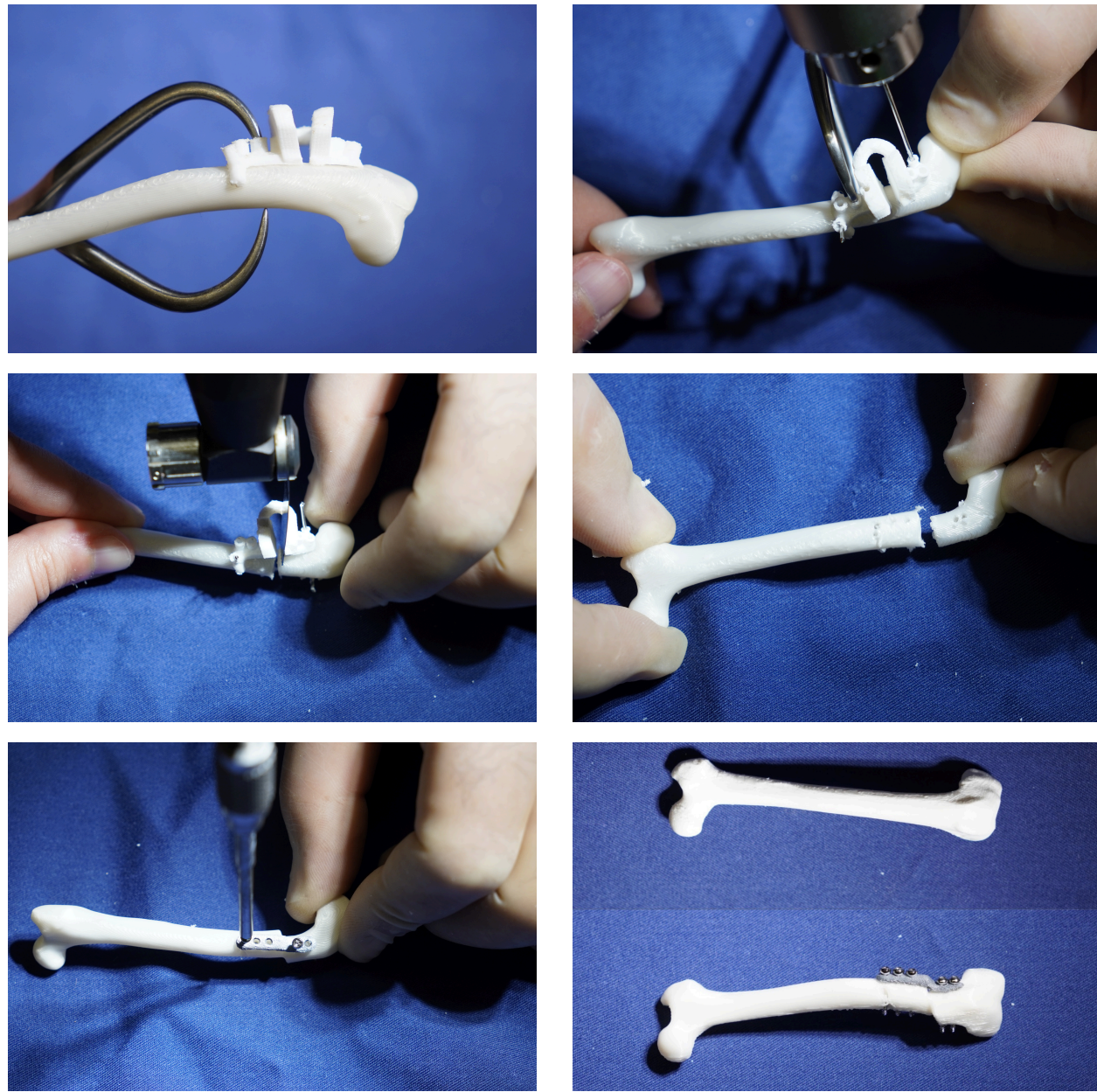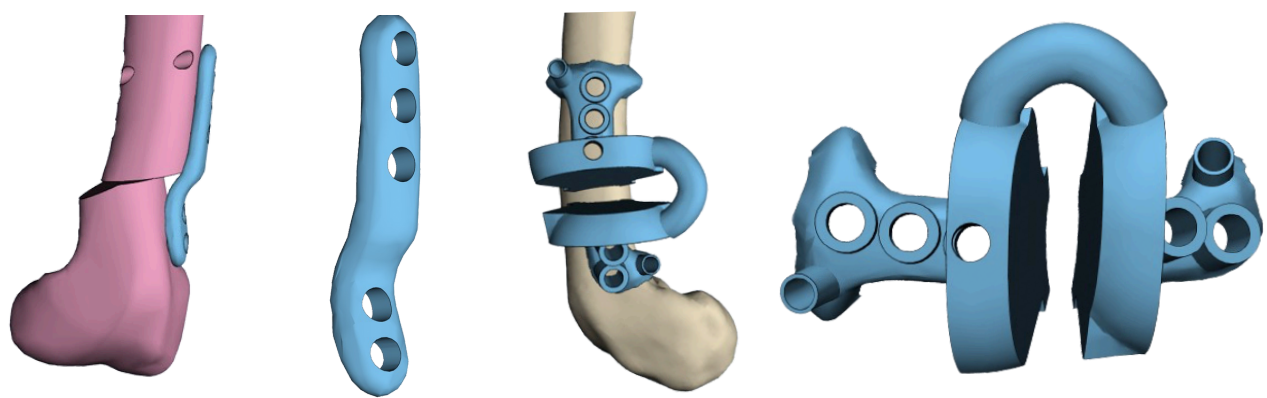
CONCLUSION

The main priority of the DFO was to correct the aLDFA (which was reduced from 115'70º to 97'31º). PSG and customised implant helped to optimise the surgeon's technical performance and clinical outcome by securing the optimal deformity reduction. The preoperative surgical planning and later practise on the 3D printed model contributed to a better understanding of the procedure and lead to error evaluation helping the further improvement of the guide prior to its definitive use.