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3D Printing of Bone Spurs Before Surgical Removal

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Project Title: 3D Printing of Bone Spurs Before Surgical Removal

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Project Background: In the US alone, total knee arthroplasty is the most common performed orthopedic surgery, with over 700,000 cases per year.¹ Overall, 21-25% underwent revision due to instability.² The stability of a TKA depends largely on soft tissue balance for proper alignment in flexion and extension. Soft tissue balancing in TKA depends on posterior femoral condylar osteophytes, which prevent full extension of the knee and increase tension posteriorly. Pre-operative soft tissue visualization is difficult and this leaves an increased chance for implant failure and revision surgery. Having a 3D model of the bone spur before and during the surgery may decrease risk of complication and enhance soft tissue modification for proper knee balancing post TKA.

Proposed Methods: We will 3D print a knee via MRI or CT that has been de-identified and provided by our mentor. The orthopedic surgeon will use this print out before or during surgery to address any concerns they have during the surgery in terms of proper balancing of the soft tissue of the knee. After approximately 10 uses within the OR, we will interview the surgeons and patients for their feedback. Patients undergoing total knee arthroplasty using the 3D printed knee will be matched with historic records of those who had undergone TKA. Rates of revision, patient satisfaction, and OR time will be compared across groups using chi-square and t-tests where appropriate.

Results: We anticipate reduced OR time, increased patient satisfaction and decreased rates of revision.

Conclusions: Our study demonstrates an initial use for 3D models as an aid or guide for total knee arthroplasty. Using a 3D model for TKA helps the surgeon visualize osteophytes and reduces the need for revision surgery. A larger study will need to be conducted in order to test the feasibility and practicality of 3D printing for surgery.

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1. ¹Gromov, K., Korchi, M., Thomsen, M. G., Husted, H., & Troelsen, A. (2014). What is the optimal alignment of the tibial and femoral components in knee arthroplasty?. *Acta orthopaedica*, 85(5), 480–487. doi:10.3109/17453674.2014.940573
 2. Kebbach, M., Grawe, R., Geier, A., Winter, E., Bergschmidt, P., Kluess, D., ... Bader, R. (2019). Effect of surgical parameters on the biomechanical behaviour of bicondylar total knee endoprostheses - A robot-assisted test method based on a musculoskeletal model. *Scientific reports*, 9(1), 14504. doi:10.1038/s41598-019-50399-3

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