HOW THE MORPHOLOGY OF HUMAN BONE AFFECTS THE APPLIED FORCES ON A SAW BLADE'S TOOTH

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1. Introduction

In orthopedic surgeries like knee replacements and osteotomies, bone cutting is often performed with a handheld oscillating saw. Achieving an optimal cut requires high accuracy, low temperature, minimal surgeon effort, and time efficiency, all of which may be influenced by the forces applied on a saw tooth [1], [2].

2. Objectives

Studies have investigated bovine bone microstructure to reduce or predict sawing forces [3], [4]. However, given inter-species variations, its transition to human bone remains limited [5], [6].This study investigates the impact of human bone microstructure on forces applied to a single saw tooth.

3. Methods

The microstructure of seven fresh-frozen human cadaveric bone samples were analyzed using a stereomicroscope to measure porosity and osteon density. These samples then were sawed in four quadrants using a single-tooth saw blade in a dedicated test set-up. The applied forces on the saw tooth were simultaneously recorded by a 6 DoF Loadcell. Then, the relationship between porosity and osteon density with cutting and thrust forces were statistically analyzed by multi regression analysis.

4. Results

Microstructure analysis of the sawed area showed porosity varying from 6–44% and osteon density from 4–24 osteons/mm². A logarithmic multi-regression model revealed a significant relationship between these properties and cutting forces (5–12 N) and thrust forces (5–13 N), explaining approximately 80% of the variance in these forces on the saw tooth.

5. Conclusion

The proposed regression model accurately predicts sawing forces and provides insights for optimizing saw blade design parameters to minimize sawing forces.

6. References

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