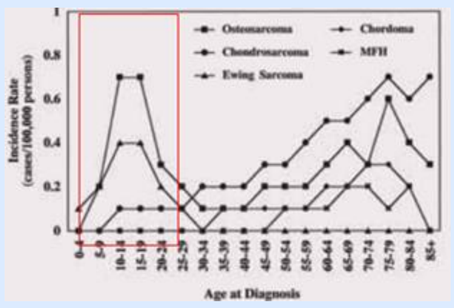
Development of an Image-guided Surgical Robot for Bone Tumor Resection

Lingzhi Kong, Lei Cao, Zheng Guo and Hao Liu, et al.

Intra-Lumenal Surgical Robot Group, State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences

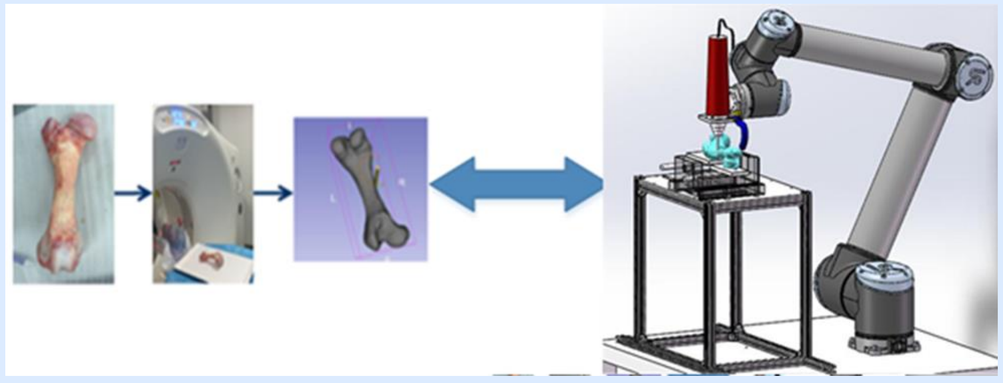
Introduction

- Clinical background: bone tumor resection

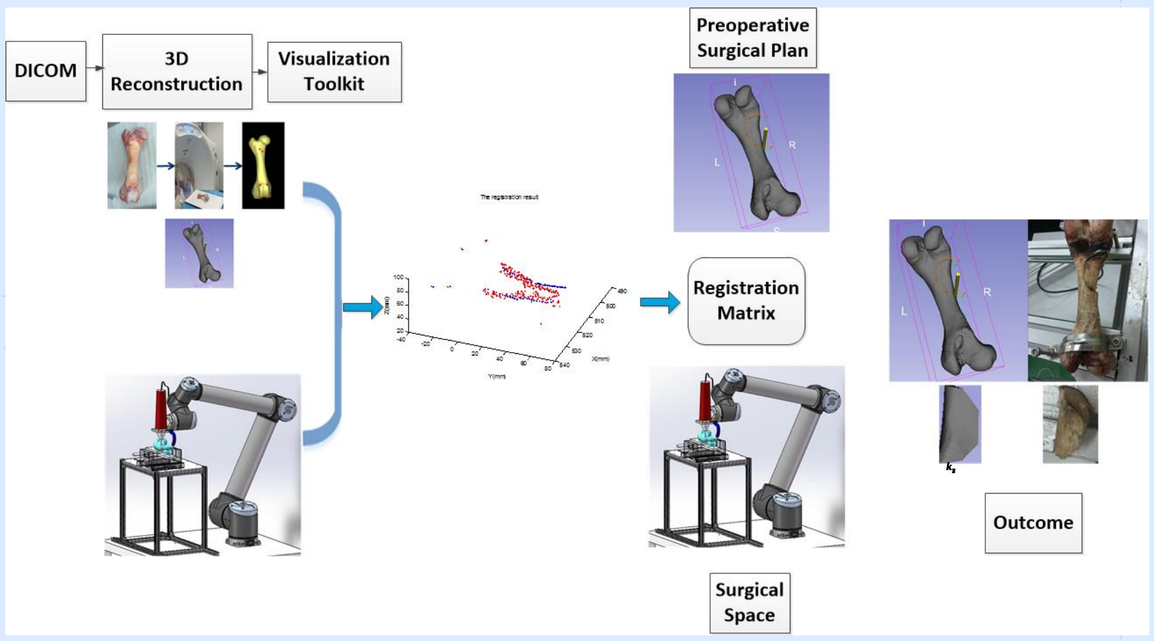


- Drawbacks of conventional bone tumor surgery:
  - Imprecise
  - Rely on the experience of surgeons
  - High labor intense on surgeons

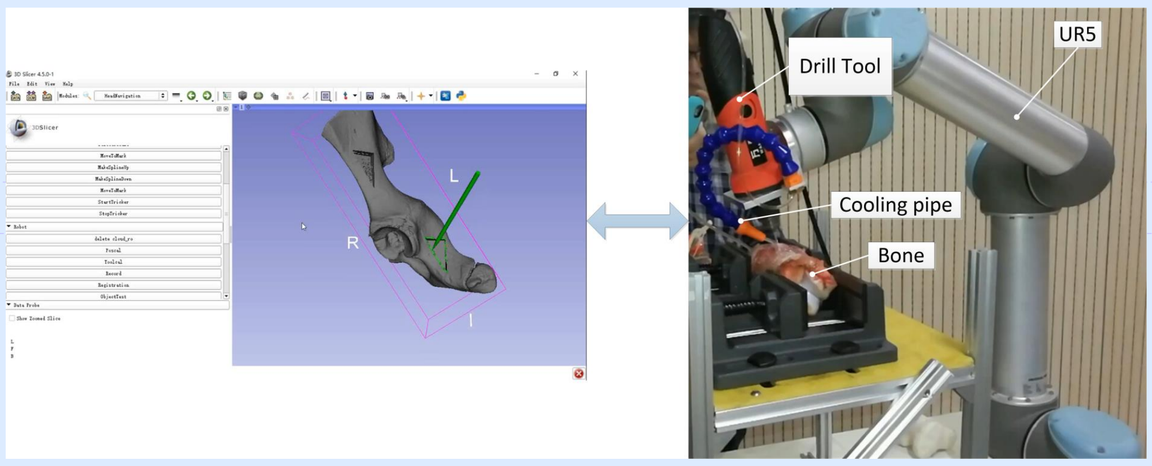
- Robotic bone tumor surgery:



Schematic Diagram



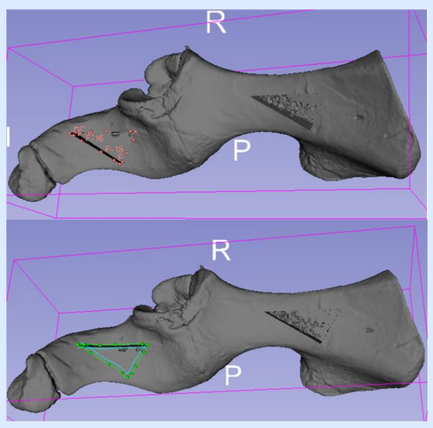
Experiment Platform



Experiment and Outcomes

- Procedure:
  - Pre-operation planning
  - Surgical tool calibration
  - Registration
  - Bone tumor resection and surgery visualization

Path Planning:



$$V_{offset} = -V_{Tool} \times V_{Path}$$

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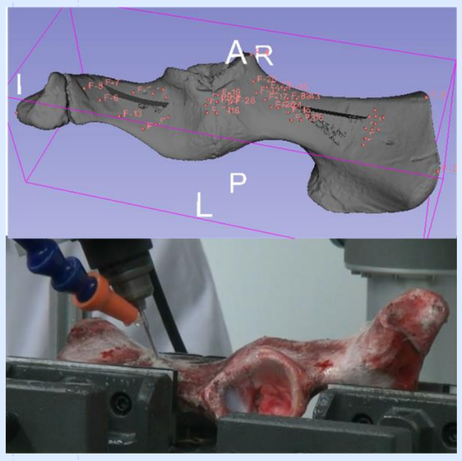
Registration:

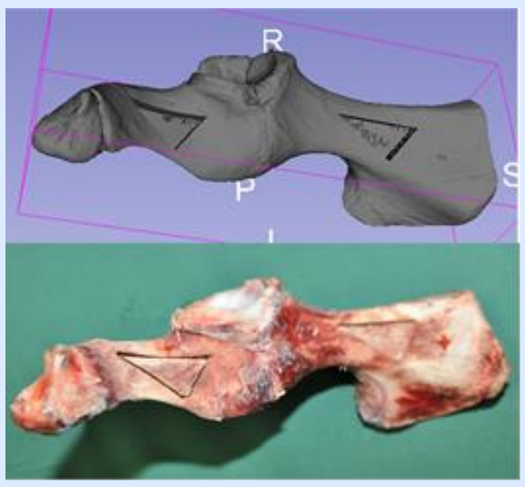


$$^{i}T_{r}^{\text{pre}} = P_i^M (P_r^M)^{-1}$$

$$f(R,T) = \sum_{i=1}^{n} \left\| P_i^k - (RP_r^k + T) \right\|^2 = \min$$

$$P_i^M = P_i^M (P_r^M)^{-1} P_r^M$$

Resection Outcome:



	Point position disparities				
	K1	K2	K3	K4	K5
Error(mm)	1.4	1.2	1.4	0.9	1.7