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Image-guided surgical techniques for cartilage repair – an animal trial

Manuela Kunz[1,2] Mark Hurtig[4] Stephen Waldman[2,3] Steven Devlin[1,2]

John Rudan[2] Davide Bardana[2] James Stewart[1,2]

[1] School of Computing at Queen's University
[2] Human Mobility Research Centre at Kingston General Hospital
[3] Department of Mechanical Engineering at Queen's University
[4] Ontario Veterinary College at University of Guelph

Purpose

Question:

Can computer guidance improve outcomes in mosaic arthroplasty?

CAMA = Computer Assisted Mosaic Arthroplasty

Three surgical methods

We compared three methods of mosaic arthroplasty:

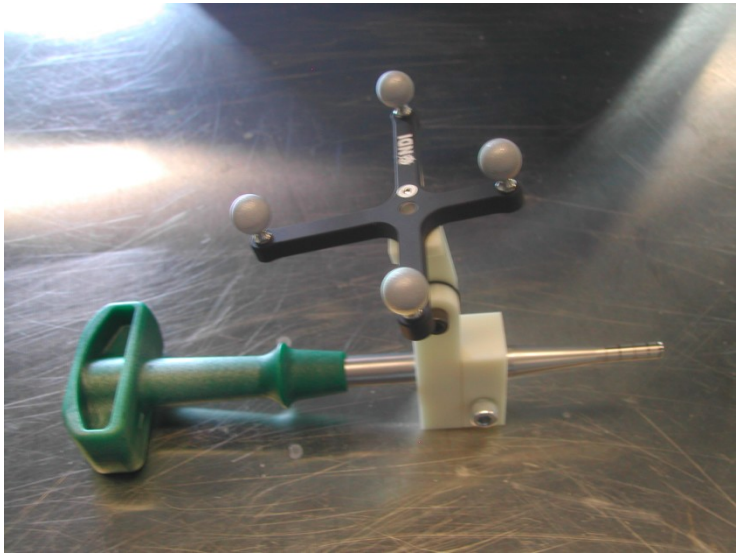


Image guided method

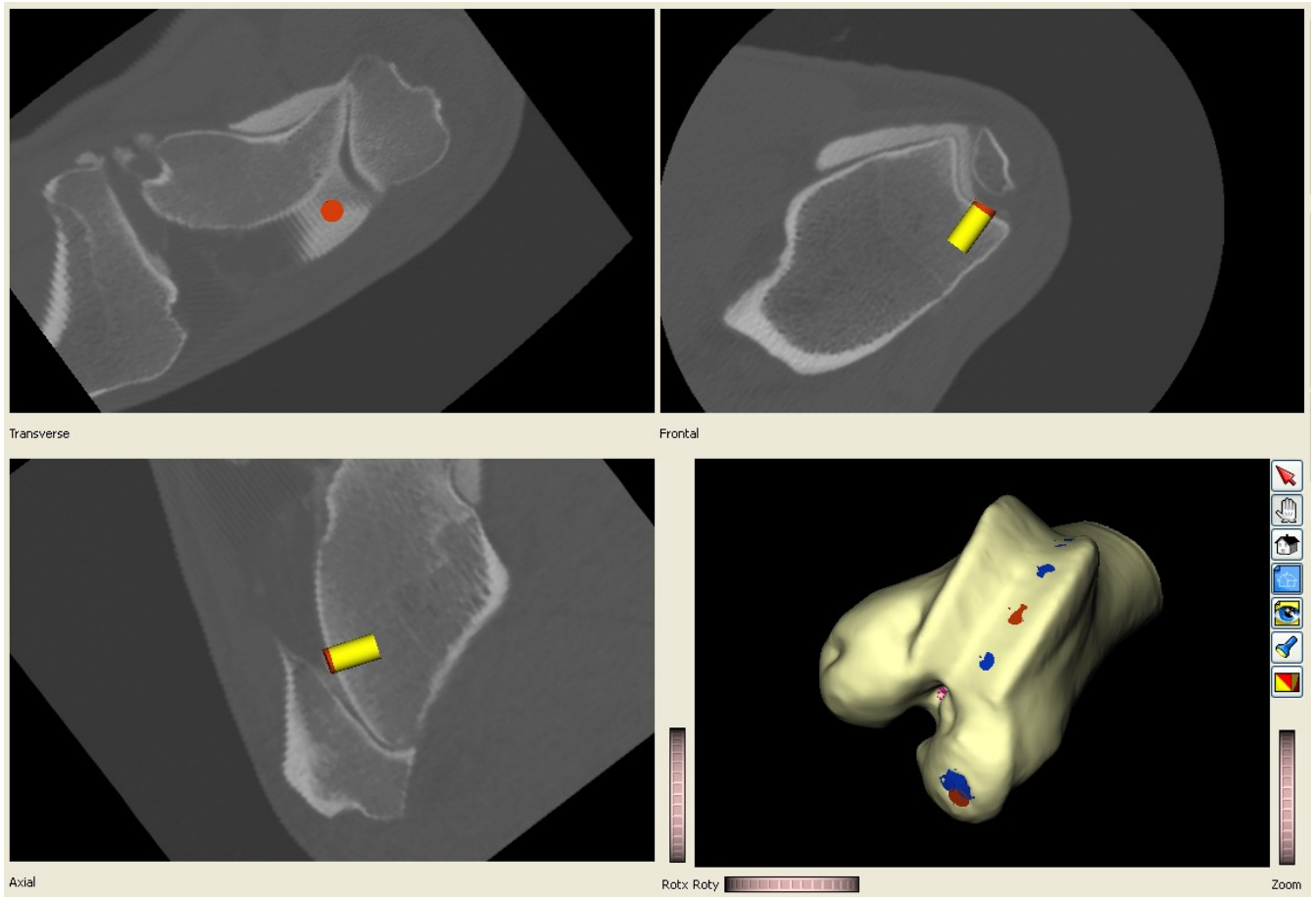
Template guided method

and the Conventional method

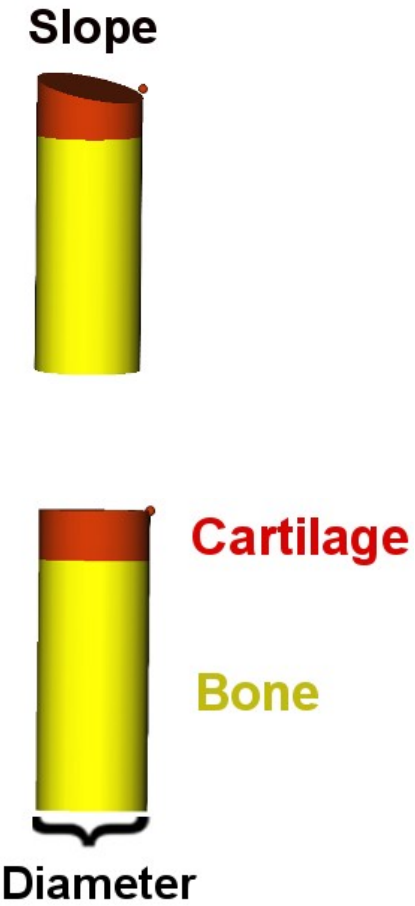
Computer planning for CAMA

1. Scan with CT arthrogram.
2. Build 3D model of bone and cartilage from the CT arthrogram.
3. Use software to position a mosaic of virtual plugs over the defect.
4. Find matching plug harvest sites.

Computer planning for CAMA

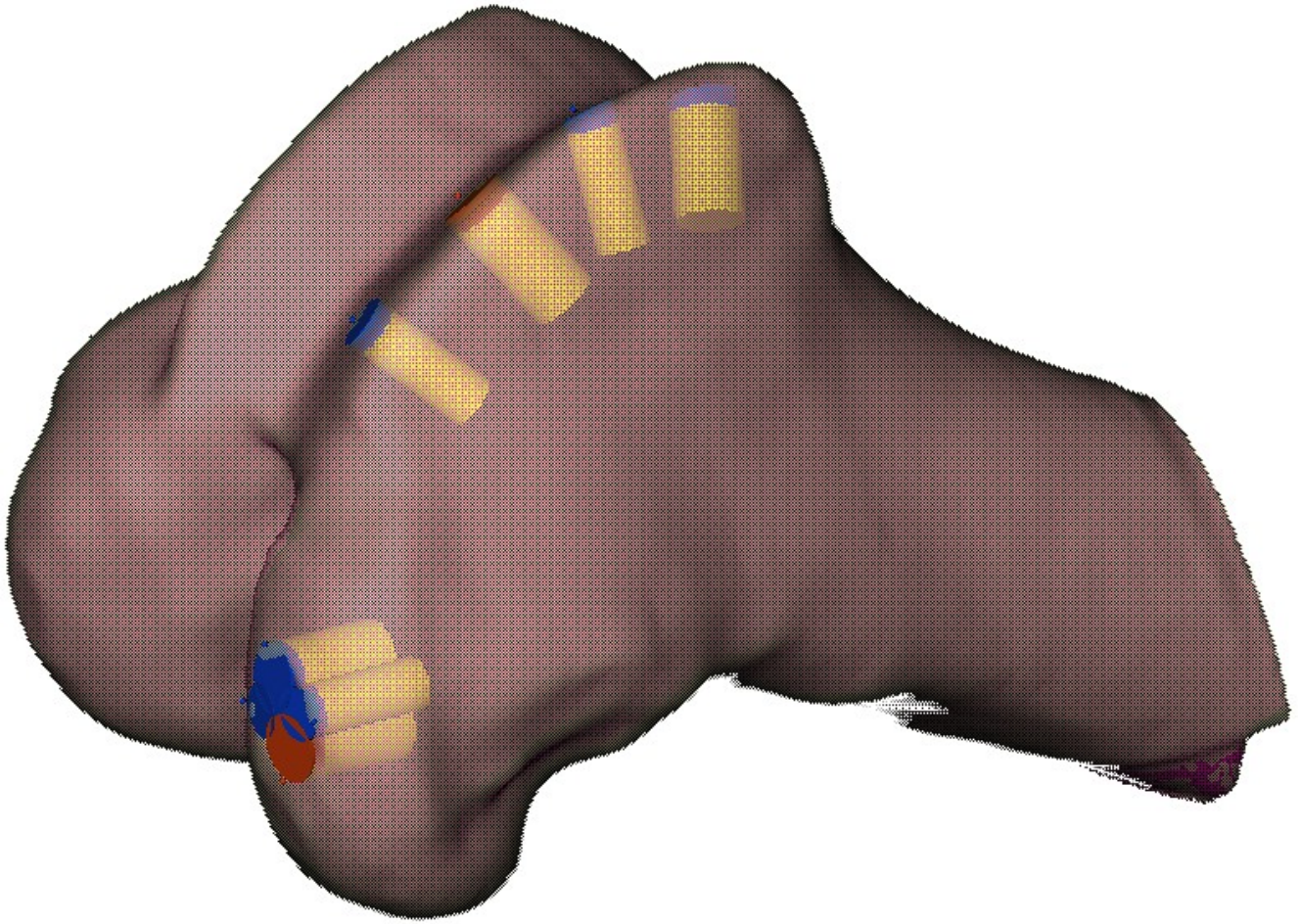


Planning software



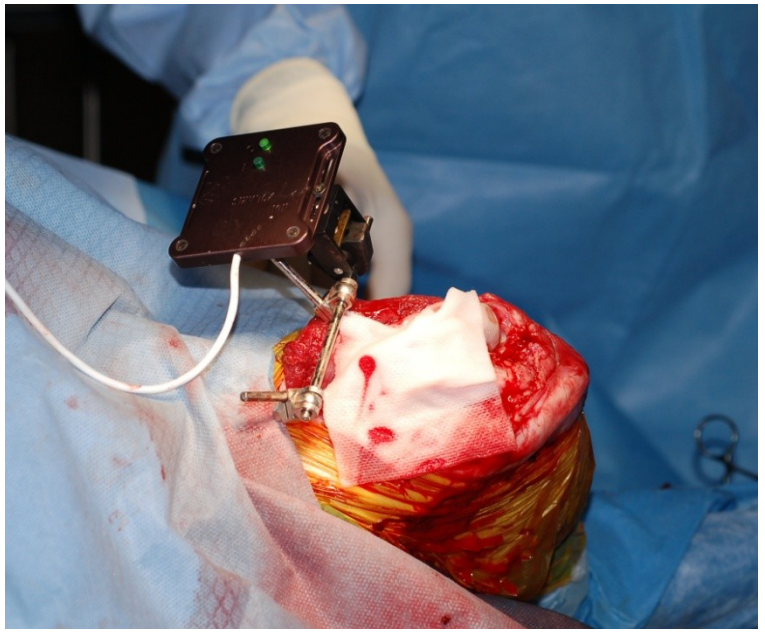
Plug geometry

Computer planning for CAMA



The final plan

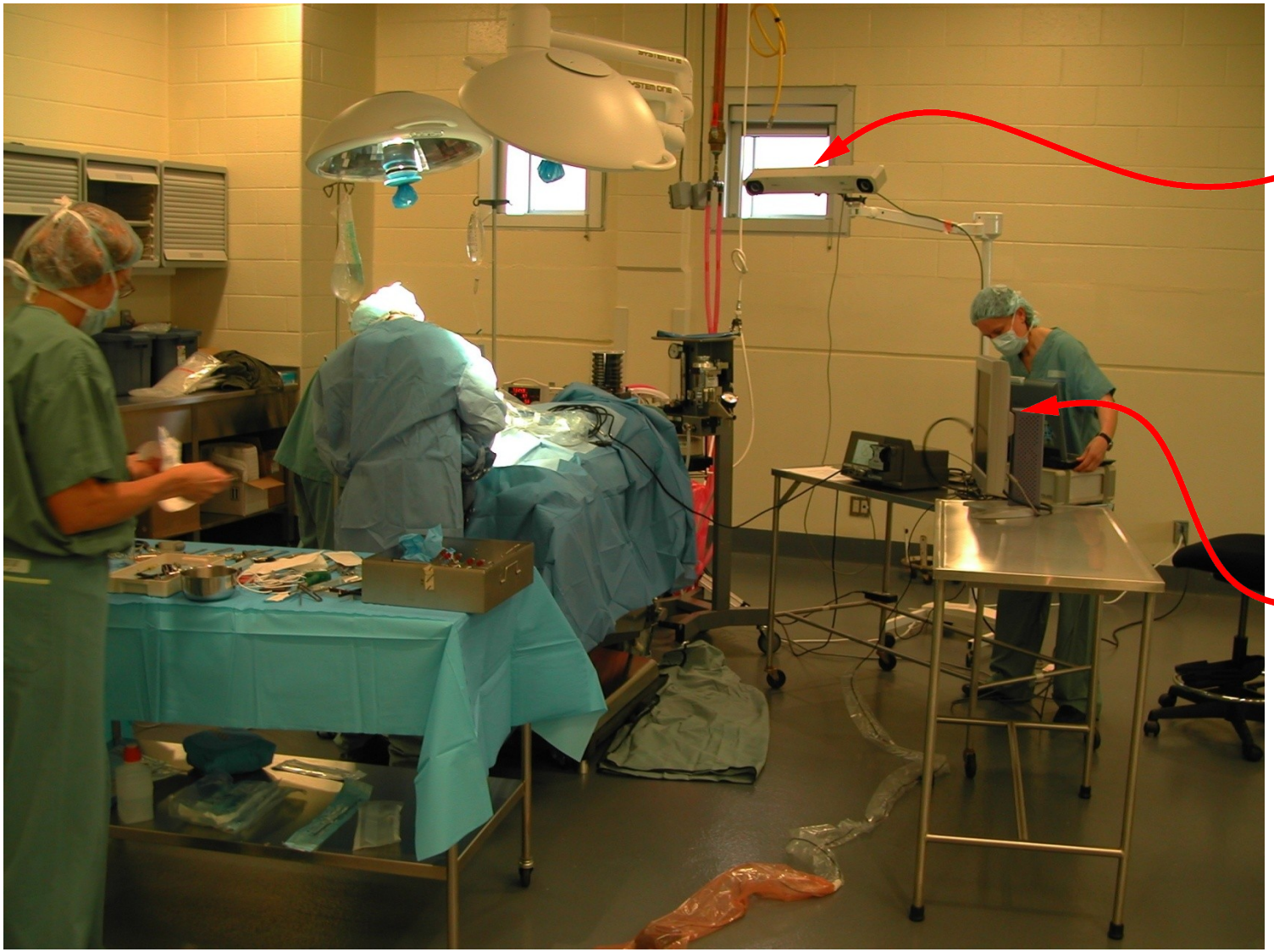
Image-guided CAMA



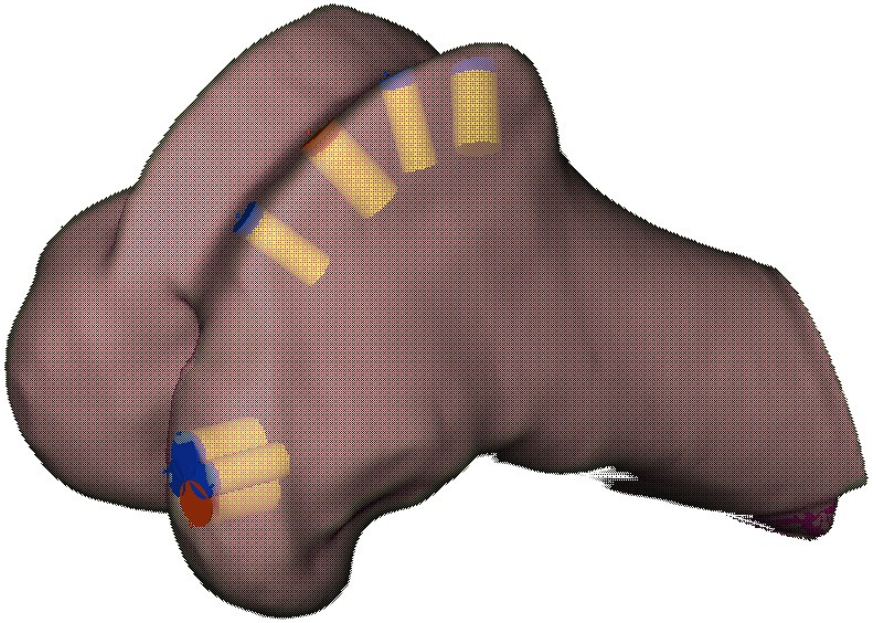
Tracker on the femur

Tracker on the tool

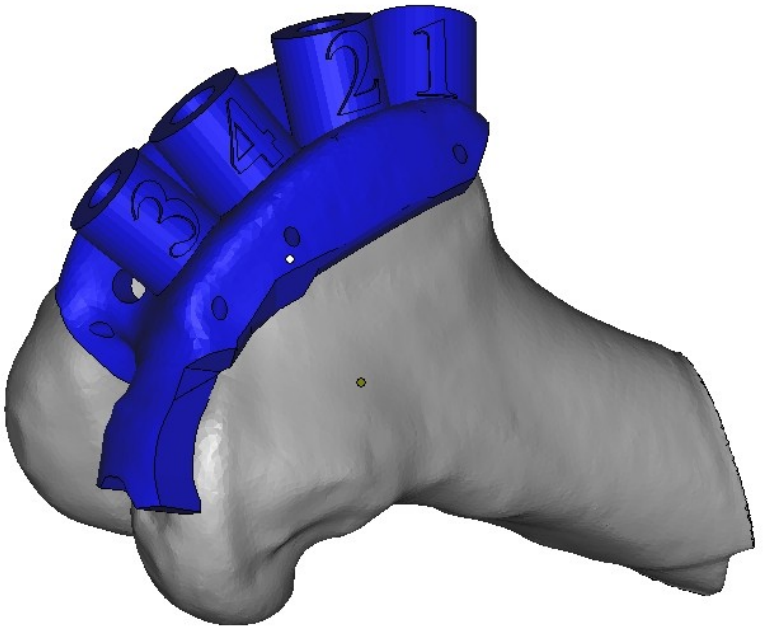
Image-guided CAMA



Template-guided CAMA



From the surgical plan ...



... to the guidance template.

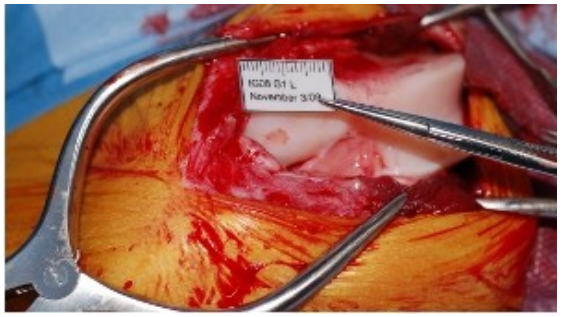
Template-guided CAMA

Separate templates are used for harvesting, drilling, and delivery.

Animal Study

15 sheep randomized into three groups:

conventional, image-guided, and template-guided



At 0 months:

Take a CT arthrogram of the original knees.

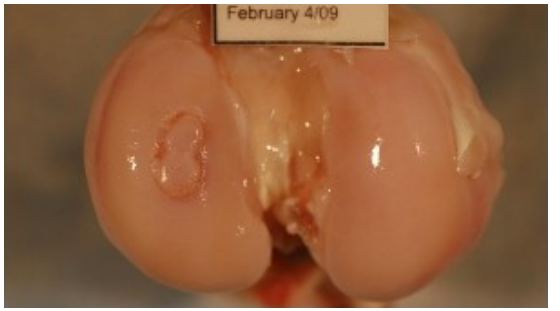
Create a defect on each knee.

At 3 months:

Take a pre-op CT arthrogram.

Plan surgery (image- and template-guided).

Perform surgery.

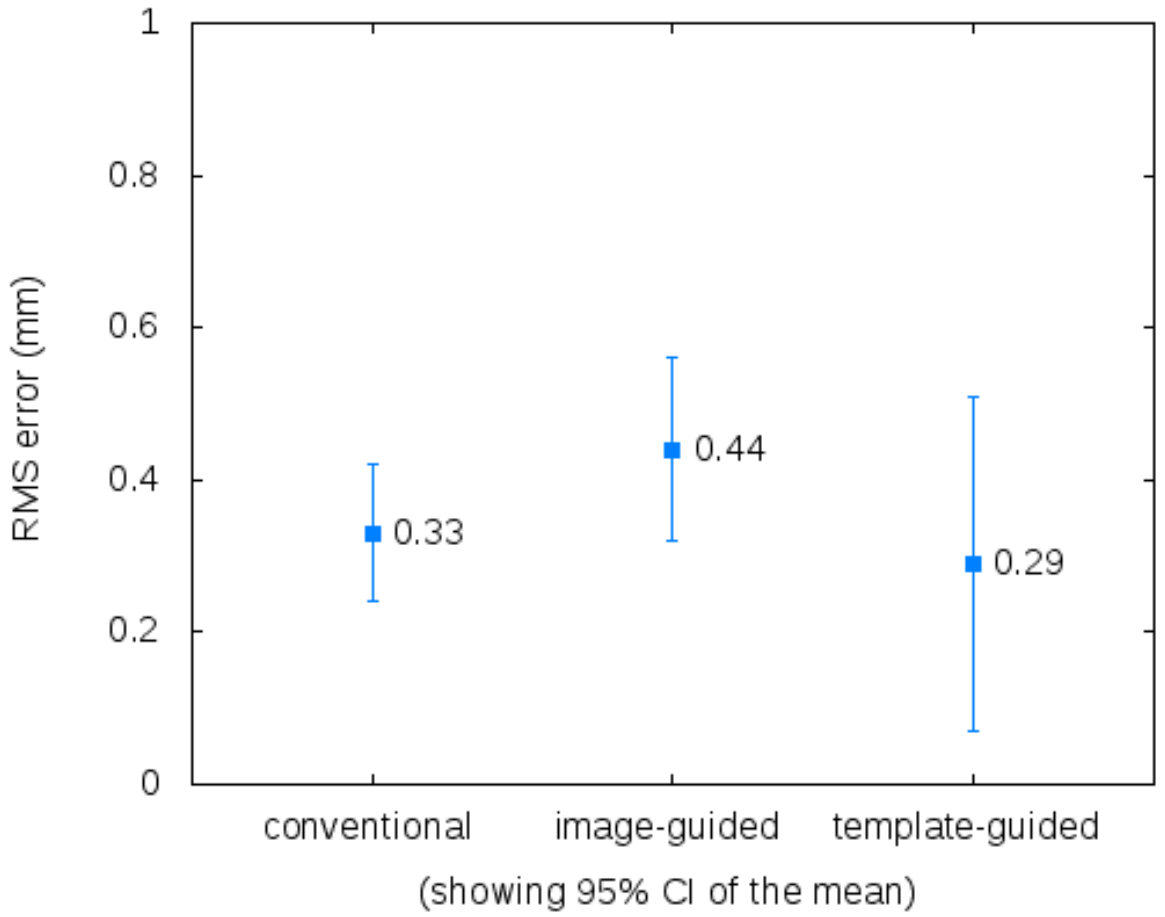


At 7 months:

Harvest and evaluate the knees.

Results

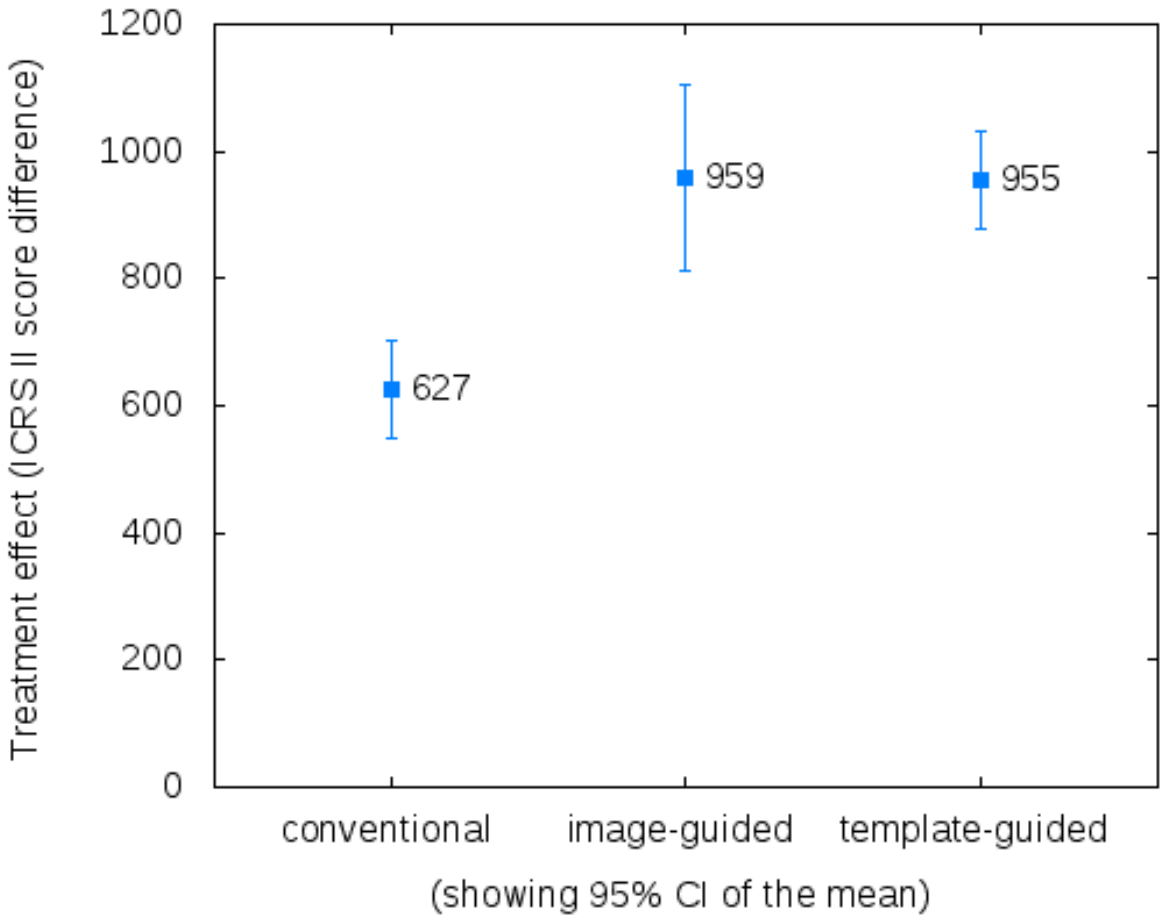
RMS error in surface shape after healing compared to original surface



No significant differences were found.

Results

Treatment effect on femoral condyle
(as difference in ICRS II* histology score compared to control knee)

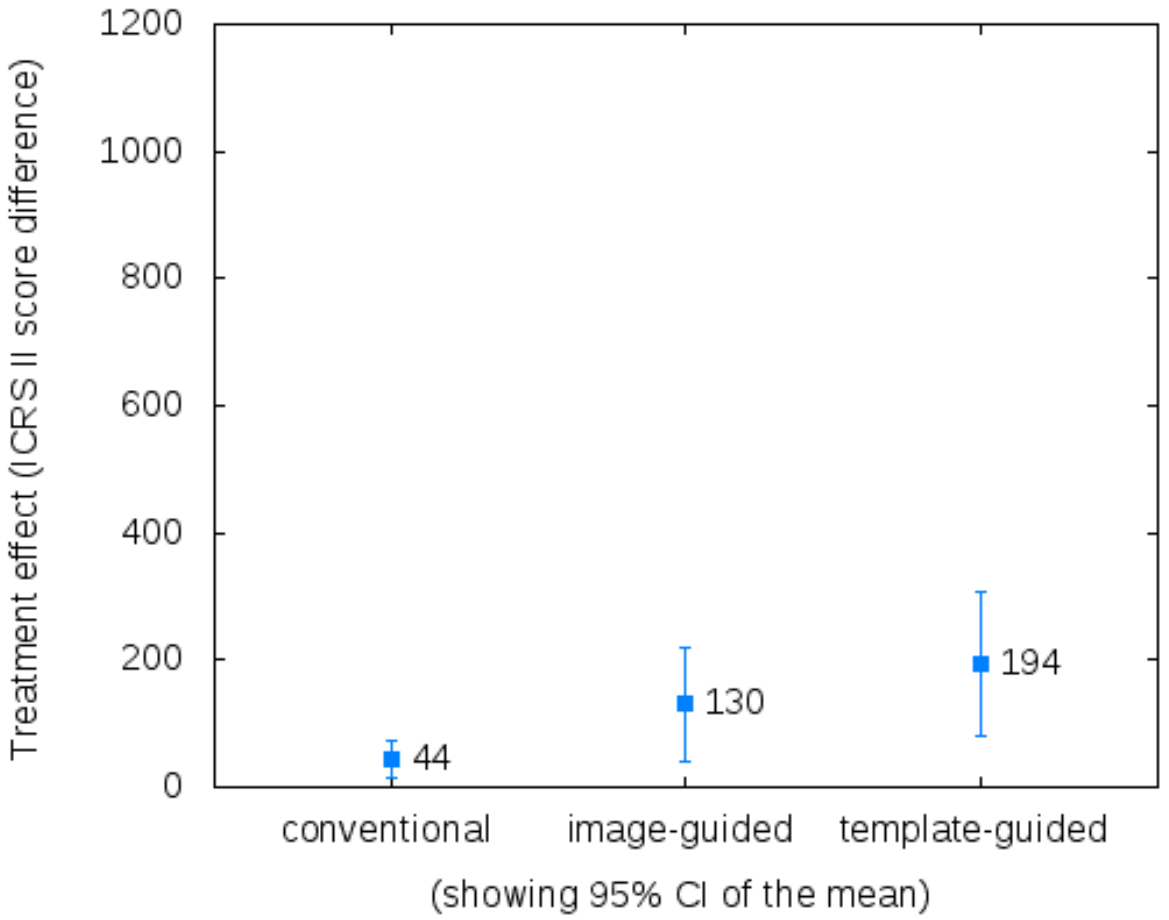


CAMA is better than conventional ($p < 0.017$).

* Mainil-Varlet *et al.*, AJSM 2010:38

Results

Treatment effect on **tibial plateau**

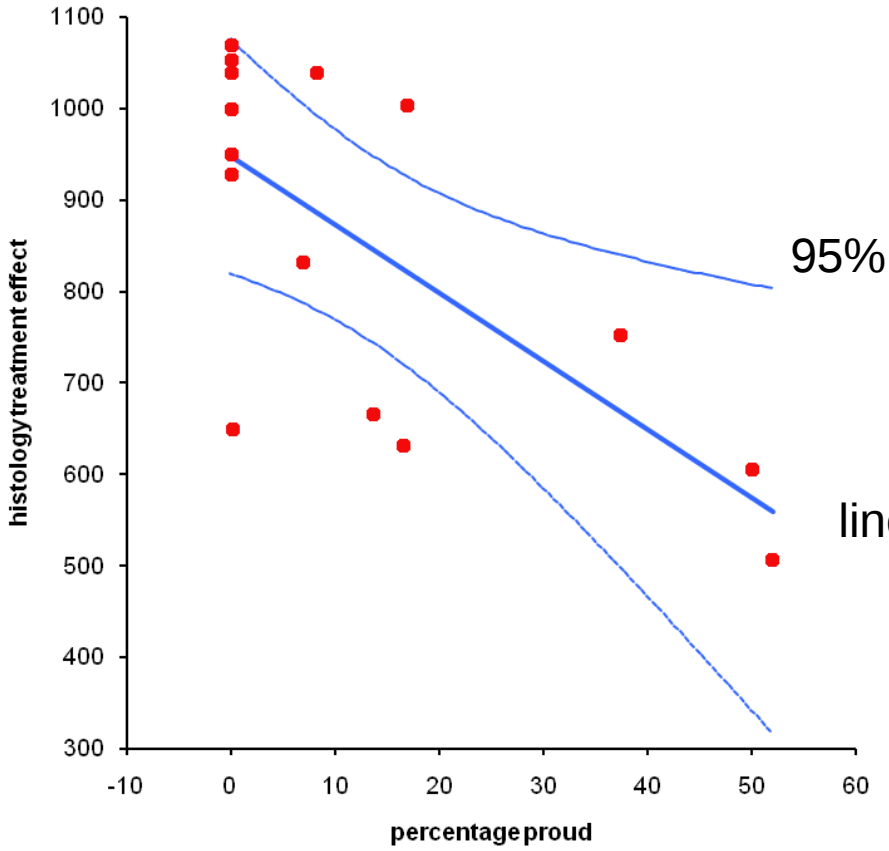


Template-guided is better than conventional (p = 0.032).

Results

Treatment effect worsens as the percentage of **proud** plugs increases.

33% proud



95% C.I.

linear fit (r^2 = 0.5, p = 0.003)

No correlation was found with **recessed** plugs.

Conclusion

Computer-assisted mosaic arthroplasty (CAMA)

can improve clinical outcomes over

the conventional technique.

Acknowledgements

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