Comparison of Range of Motion between 2-year Clinical Outcomes and Predictions of Preoperative Planning Software for Reverse Shoulder Arthroplasty

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Preoperative Planning Software

- Provides 3D visual insight of patient anatomy
- Allows surgeons to virtually conduct surgical techniques
- Plans the optimal implant size and position
- Helps predict impingement-free range of motion (ROM)

To enhance decision making
leading to improved clinical and functional outcomes for patients

What is the accuracy of predicted ROM??

Objective

To compare 2-years ***clinical*** range of motion **(C-ROM)** with the preoperative planning ***predictions*** **(P-ROM)**

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Comparison of range of motion between 2-year clinical outcomes and predictions of a static scapula preoperative planning software for reverse shoulder arthroplasty

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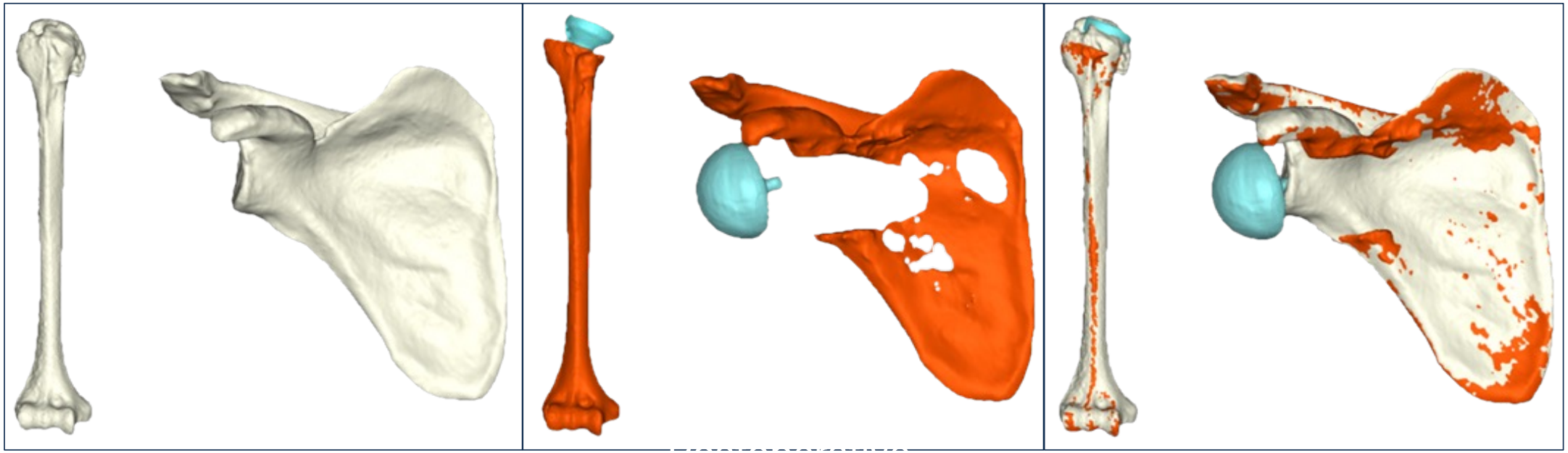
Prospective study

- 75 Patients who underwent RSA from October 2017 to April 2021

Inclusion Characteristics	Exclusion Characteristics
• Aequalis Reverse II implant • 12 weeks post-operative CT images compatible with software protocol • Two-years clinical follow-up	•Any other RSA implant •Without 12 weeks post-operative CT images •CT not compatible with software protocol •Without two-years clinical follow-up •Fracture •Revision surgery

Human Ethics Review Committee (HREC 19/32)

Image Processing

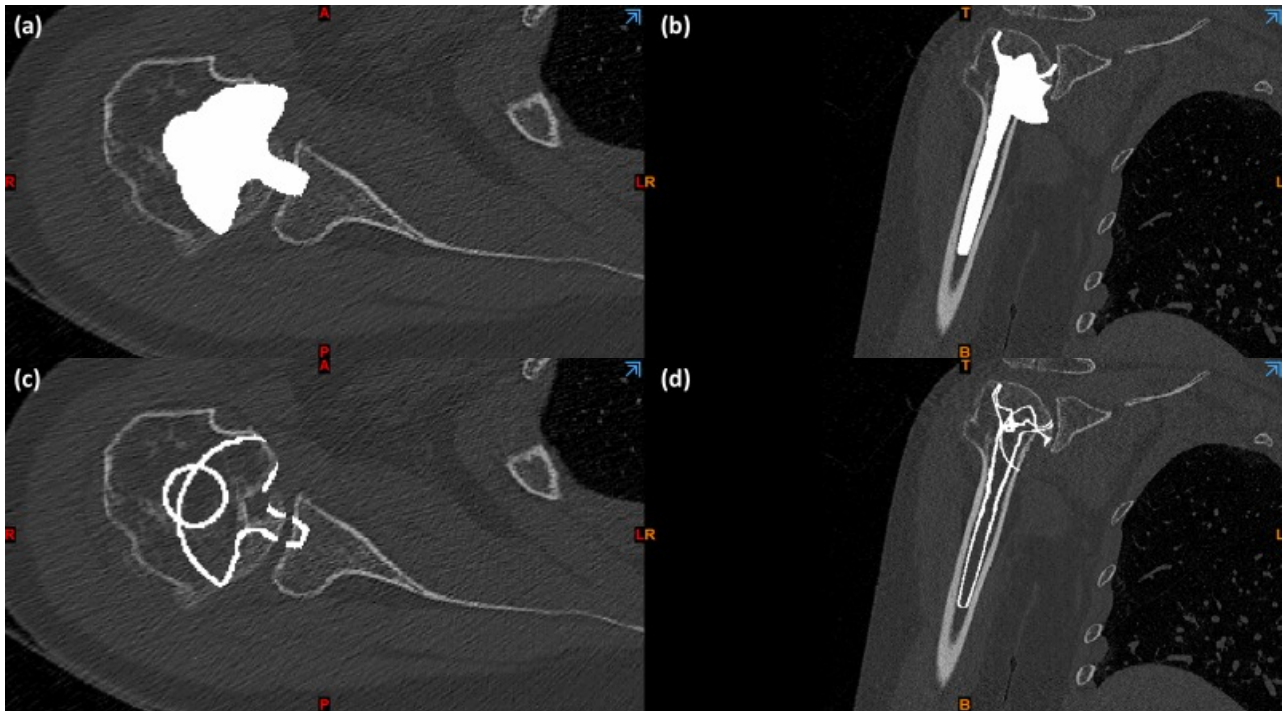


Segmentation of preop CT images

Segmentation of postop CT images to show implant position

Overlay preop and postop images using registration algorithm

Implant Print Method

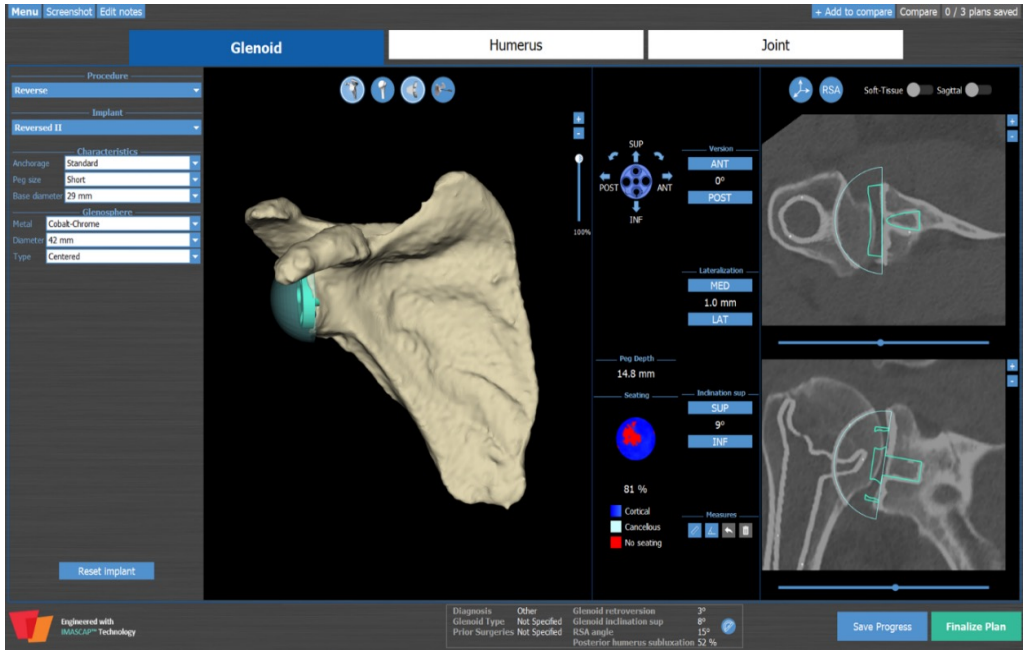


Through the registration, the Implant Print Method was developed.

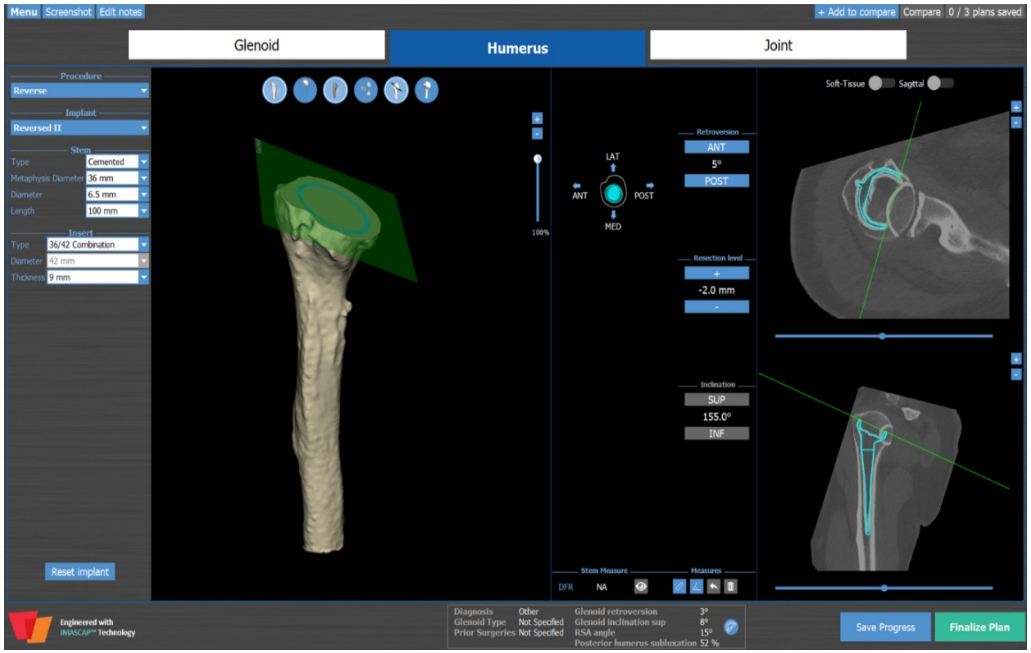
This created an implant print within the inner volume in the preop CT images.

This serves as a guide for replicating into the planning software the actual implant positions executed intraoperatively, without interfering with the algorithm of the planning software.

Through the Implant Print Method, planning was done using the actual implant sizes and positions from the surgery. Predicted ROM was then obtained.



Glenoid side



Humerus side

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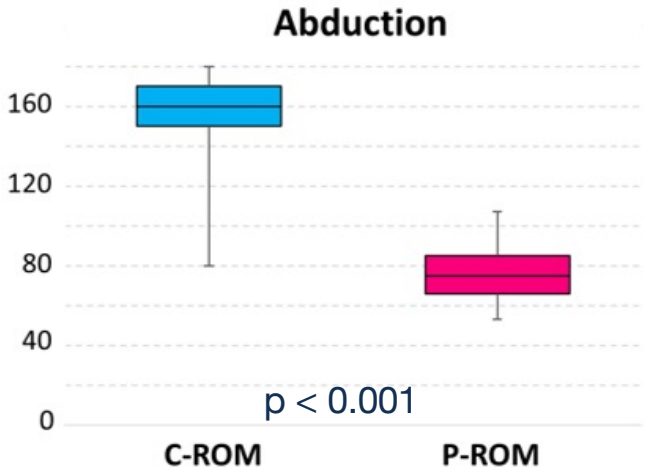
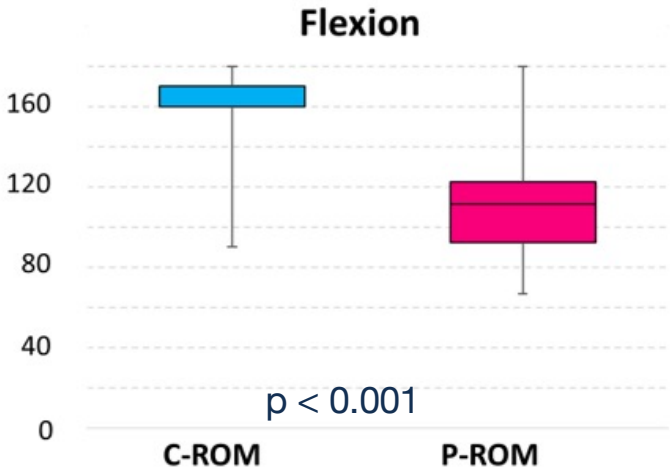
Results



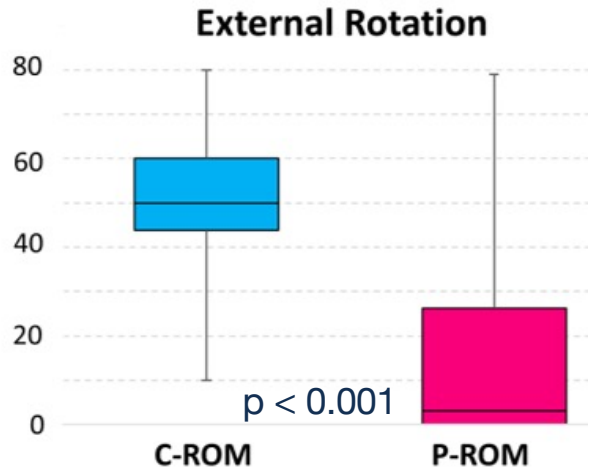
C-ROM: 154 ± 20.8 (80, 180)

P-ROM: 77 ± 13.0 (53, 107)



C-ROM: 160 ± 17.1 (90, 180)

P-ROM: 110 ± 24.0 (67, 180)



C-ROM: 52 ± 14.0 (10, 80)

P-ROM: 13 ± 19.1 (0, 79)

P-ROM are **significantly lower** than C-ROM

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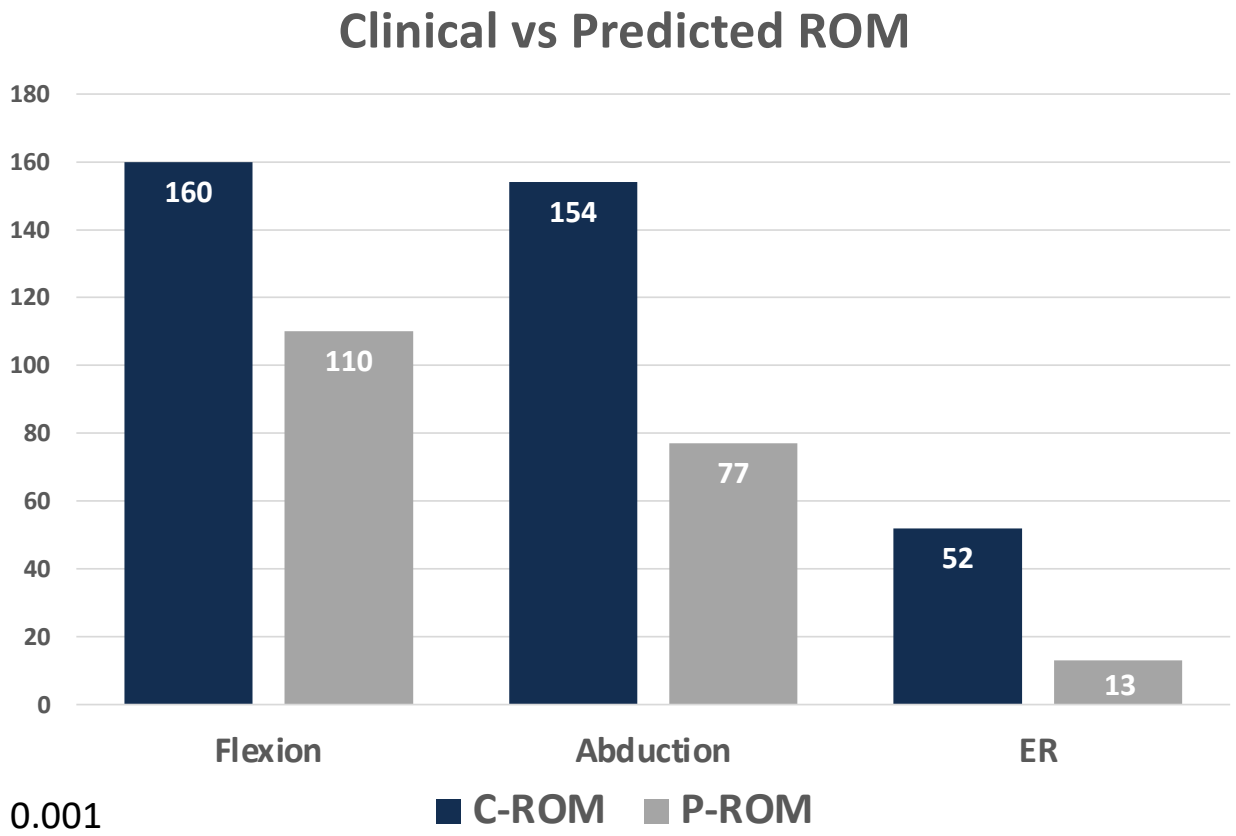
Results



$p < 0.001$

Average discrepancy

Flexion: 50°

Abduction: 77°

ER: 39°

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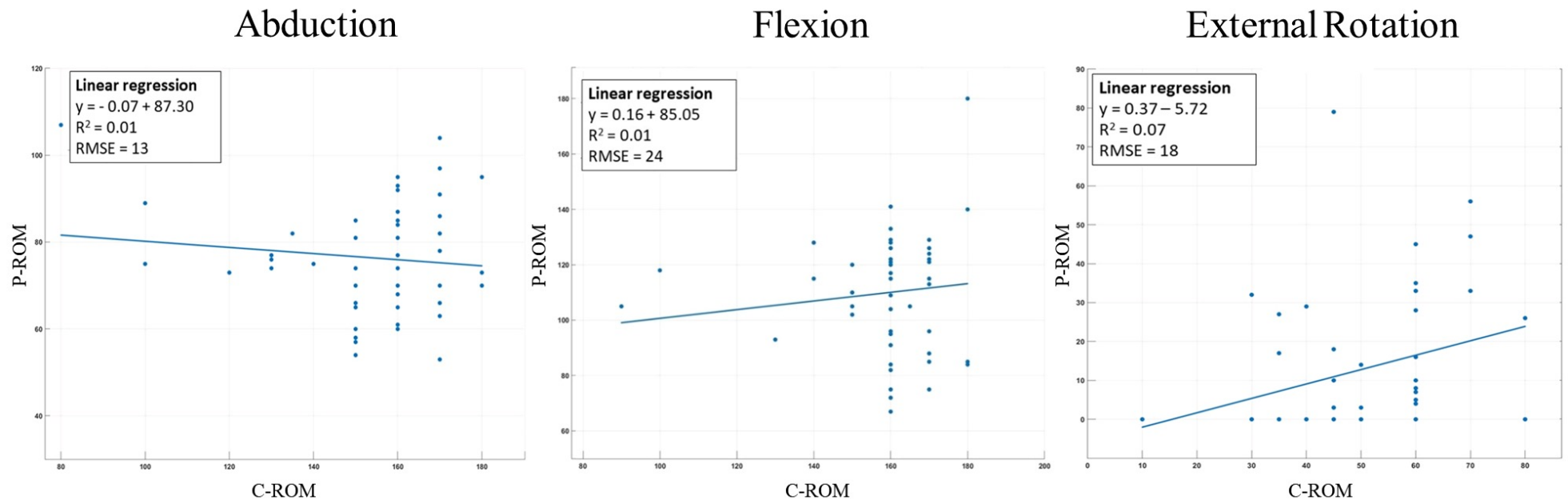
Results



Linear regression analysis showed **no correlations** for abduction, flexion, and external rotation between C-ROM and P-ROM

Discussion

Previous studies have shown similar results of having lower predicted ROM as compared to clinical ROM

Study	Predicted	Clinical	Difference
Sheth et al, 2021	FF: 95 Abd: 75 ER: 20	Passive FF: 157 Active FF: 140 Abd: 156 ER: 40	Passive FF: 62 Active FF: 45 Abd: 81 ER: 20
Baumgarten et al, 2023	FF: 122 Abd: 81 ER: 47	FF: 142 Abd: 136 ER: 32	FF: 20 Abd: 55 ER: [15]
Berhouet et al, 2023	FF: 91 Abd: 81 ER: 24	Passive FF: 141 Passive Abd: 136 ER: 19	FF: 50 Abd: 55 ER: [5]
CURRENT STUDY	FF: 110 Abd: 77 ER: 13	FF: 160 Abd: 154 ER: 52	FF: 50 Abd: 77 ER: 39

Conclusion

- 2-years clinical C-ROM were compared with preoperative planning software P-ROM
- Precise **replication of implant position** based on **postoperative CT images** provided insight of planning software into ROM software feature in RSA
- **Current planning software** alone **are not accurate** in predicting ROM
- Further development of planning software is necessary to account for **soft tissue** and **scapulothoracic movement**

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