# Can Preoperative Planning Predict Clinical Postoperative Range of Motion Differences between Two Humeral Designs in Reverse Shoulder Arthroplasty?

Marc-Olivier Gauci[1], Laure Glevarec[1], Caroline Cointat[1], Pascal Boileau[2], Nicolas Bronsard[3], Yann Pelletier[1], Gonzalez Jean-François[4]
[1]Shoulder Orthopaedics, [2]ICR, [3]Public Hospital, [4]Shoulder Orthopaedics, University Hospital

INTRODUCTION:

From the 2010s, the development and validation of 3D preoperative planning software based on CT-scan have allowed surgeons to better understand RSA biomechanics and to simulate implant positioning. Recently, prediction of glenohumeral joint mobility has been implemented to anticipate bone impingement and to improve clinical postoperative RoM. While the efficiency of the use of preoperative planning and patient-specific guides (PSG) during the surgery procedure has been demonstrated multiple times, there is no evidence yet of its clinical relevance regarding the postoperative glenohumeral joint mobilities.

We aim to predict a clinical difference in the postoperative range of motion (ROM) between two RSA implant designs INLAY-155° and ONLAY-145° using a preoperative planning software. We hypothesized that preoperative planning could anticipate the differences in postoperative clinical ROM between two humeral stem designs and by keeping the same glenoid implant.

METHODS:

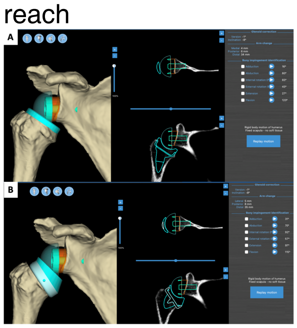
Thirty-seven patients (14 men and 23 women, 76±7yo) underwent a BIO-RSA (Bony Increased Offset-RSA) with the use of preoperative planning and an intraoperative 3D-printed patient specific guide for glenoid component implantation between January 2014 and September 2019 with a minimum follow up of 2 years. Two types of humeral implants were used: Inlay with 155° inclination (Inlay-155°) and Onlay with 145°inclination (Onlay-145°) (Figure 1). Glenoid implants remained unchanged. RSA-angle and lateralization shoulder angle (LSA angle) were measured (Figure 2) to confirm the good positioning of the glenoid implant and the global lateralization on postoperative X-rays. Correlation between simulated and clinical ROM were studied. Simulated and last follow-up active anterior elevation (AAE), abduction, and external rotation (ER) were compared between the two types of implants.

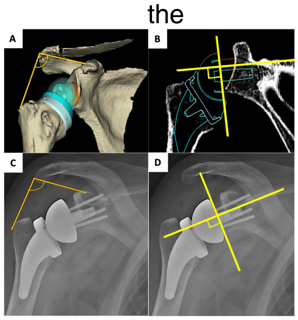
RESULTS:

No significant difference in RSA and LSA was found between planned and postoperative radiological implants' position. Clinical ROM at last follow up were always significantly different from simulated preoperative ROM. A moderate but significant correlation existed for AAE, abduction, and ER (respectively r=0.45, r=0.47 and r=0.57, p<0.01) (Figure 3). AAE and abduction were systematically underestimated (126±16° and 95±13° simulated vs. 150±24° and 114±13° postoperatively, p<0.001) while ER was systematically overestimated (50±° simulated vs. 36±19° postoperatively, p<0.001). Simulated abduction and external rotation highlighted a significant difference between Inlay-155° and Onlay-145° (12±2°, p=0.01 and 23±3°, p<0.001) (Table I) and this was also retrieved clinically at last follow up (23±2°, p=0.02 and 22±2°, p<0.001).

DISCUSSION AND CONCLUSION:

This study is the first to evaluate the clinical relevancy of predicted ROM for RSA preoperative planning at mid-term follow up. Motion that involves scapulothoracic joint (AAE and abduction) are underestimated while ER is overestimated. However, preoperative planning provides clinically relevant ROM prediction with a significant correlation between both and brings reliable data when comparing two different types of humeral implants (Inlay-155° and Onlay-145°) for abduction and ER. Thus, ROM simulation is a valuable tool to optimize implant selection and to choose RSA implants to reach the optimal RoM.





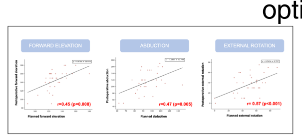



Table I. Comparison between preoperative simulated and postoperative mobilities, comparison between groups

| | INLAY-155° (Aequalis Reverse) | | ONLAY-145° (Ascend Flex) | | |
|---|---|---|---|---|---|
| | N = 21 | SD | N = 16 | SD | *p* |
| **FORWARD ELEVATION** | | | | | |
| Simulated | 129° | 16 | 133° | 18 | 0.51 |
| Postoperative | 142° | 23 | 148° | 25 | 0.55 |
| **ABDUCTION** | | | | | |
| Simulated | 100 | 12 | 88 | 13 | *0.01* |
| Postoperative | 125 | 29 | 102 | 29 | *0.02* |
| **EXTERNAL ROTATION** | | | | | |
| Simulated | 40° | 18 | 63° | 11 | *<0.001* |
| Postoperative | 27° | 17 | 49° | 16 | *<0.001* |