

# **3D preoperative planning and patient specific instrumentation improve glenoid component positioning**

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# Conflict of Interest

- DePuy – Synthes Royalty
- DJO Royalties and consultation
- Wright - Tornier- Royalties
- Lippincott Williams and Wilkins: Royalties
- **Custom Orthopaedic Solutions: Equity**
- **COS relevant to this presentation**

# The Problem:

We are dealing with widely variable

- Patient Pathology: 3D deformity making surgical orientation difficult
  - Ability to translate a pre operative plan in the OR
- Skill of the surgeon
- How do we get a reproducible and accurate method of preparing the glenoid bone to place the glenoid component in the desired position?

# Our Questions

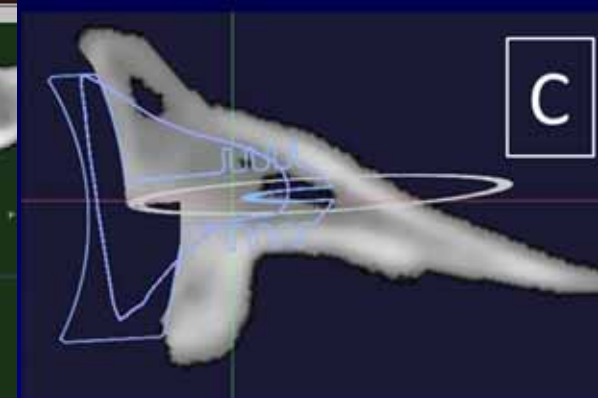
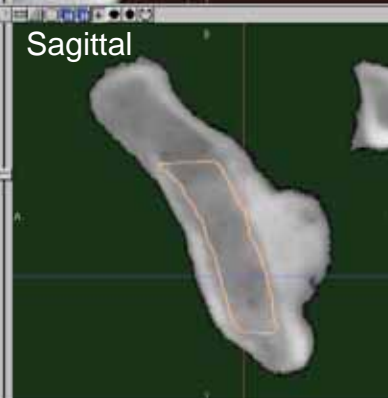
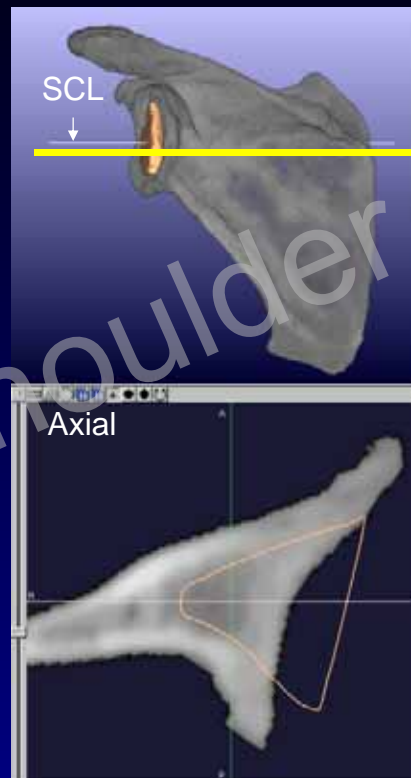
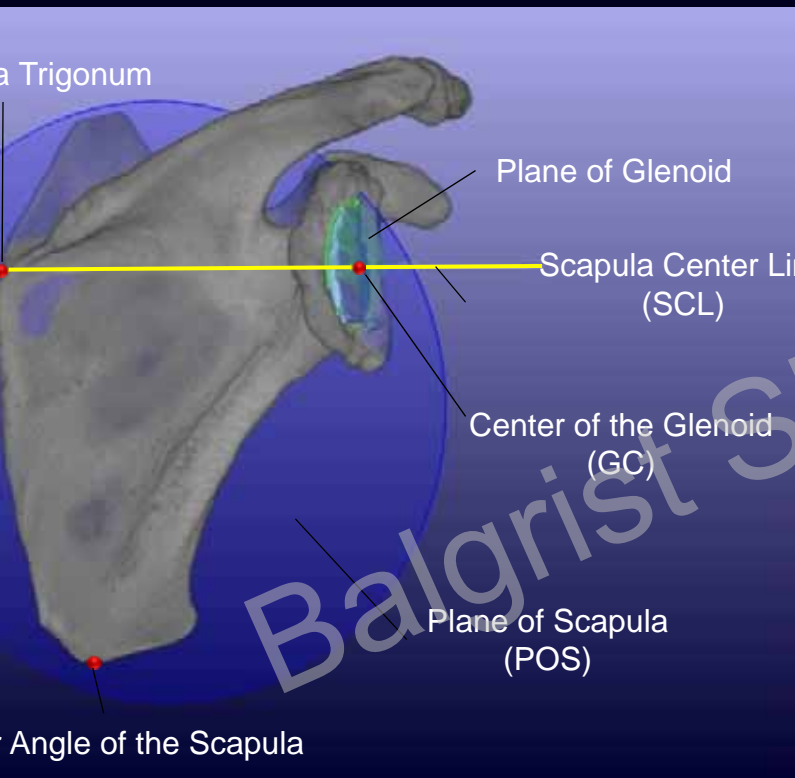
- Will 3D CT based imaging and PSI improve the precision of glenoid component placement?
- Is one type of PSI more accurate than another?

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# Study Design

- **Single Center, 157 patients with primary OA randomized into five groups of PSI**
- **Anatomic TSA in Primary OA Same surgical procedure and same implant**
- **2 very experienced shoulder surgeons**
- **Post op 3D MAR CT all patients registration of the scapula with pre op 3D plan**

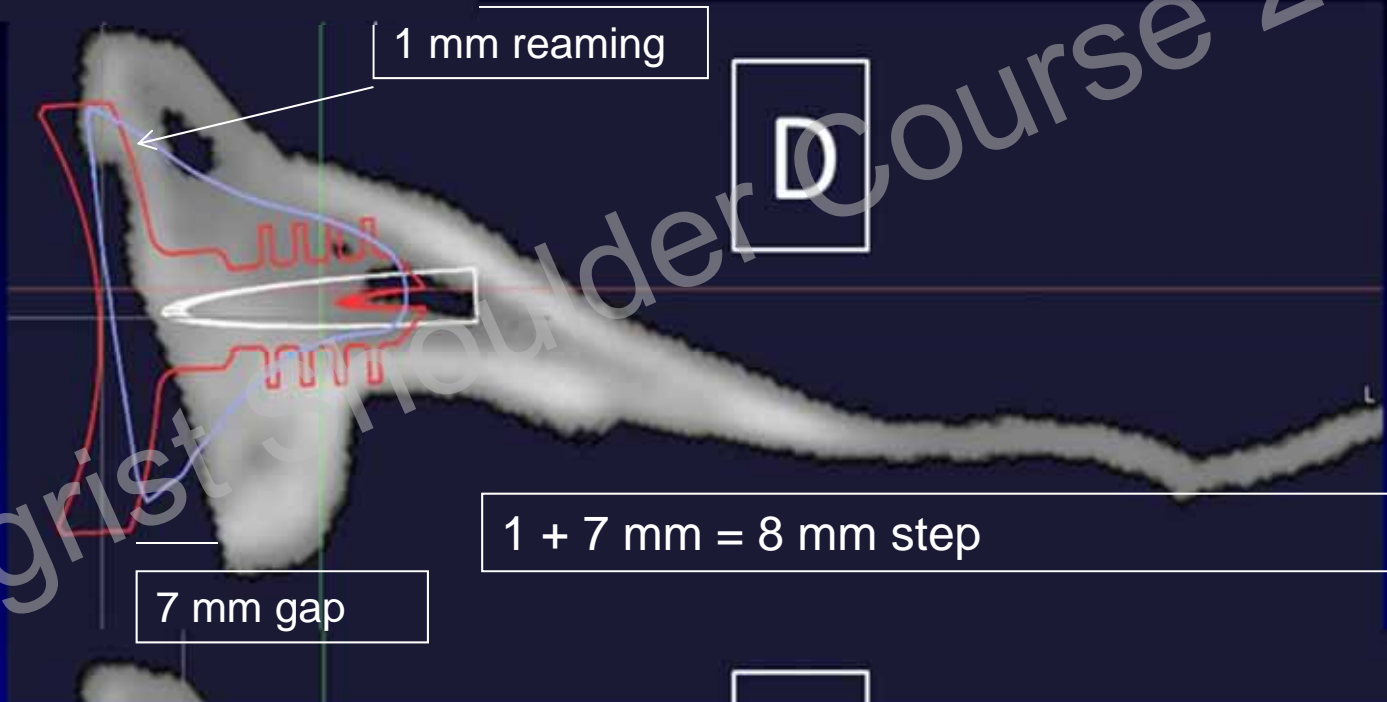
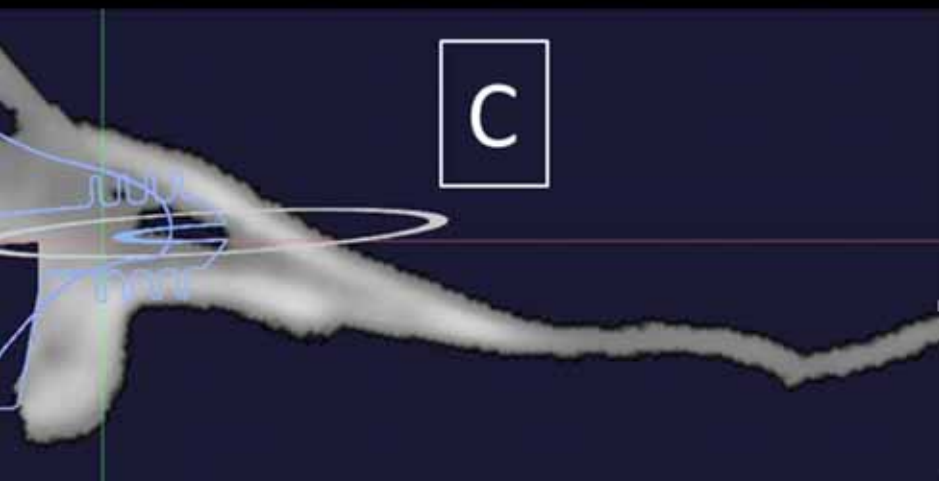
# ALL patient recieved 3D CT imaging to define the pathology implant type and position



# Five Groups of Instrumentation

## All with 3D planning and Implant Templating

- 3D planning and **Standard Instrumentation** 62 patients (two groups)
- **Single use PSI**: 37 patients
- **Reusable PSI**: 58 patients
  - Software to a 3D printed **surrogate model**
  - Software to a adjustable and **reusable surrogate jig**

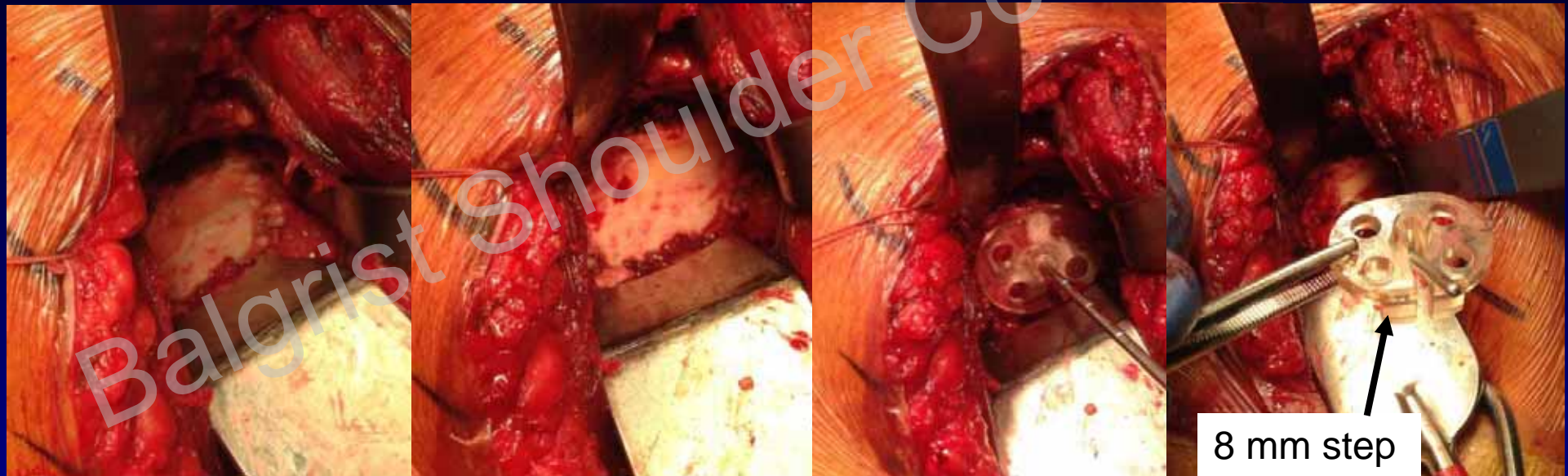


Pre-operative planning and creating a PSI from a standard instrumentation system



# 1. Use of standard instrumentation

“PSI” = the software and the patient specific use of a standard instrument



## 2. Single Use PSI Time of Surgery

### “Real Time PSI” Intra-operatively fabricated

Pin location  
defined by  
software  
and bone  
ax to the  
trochanter



PMMA  
Mold in the  
surgical  
site

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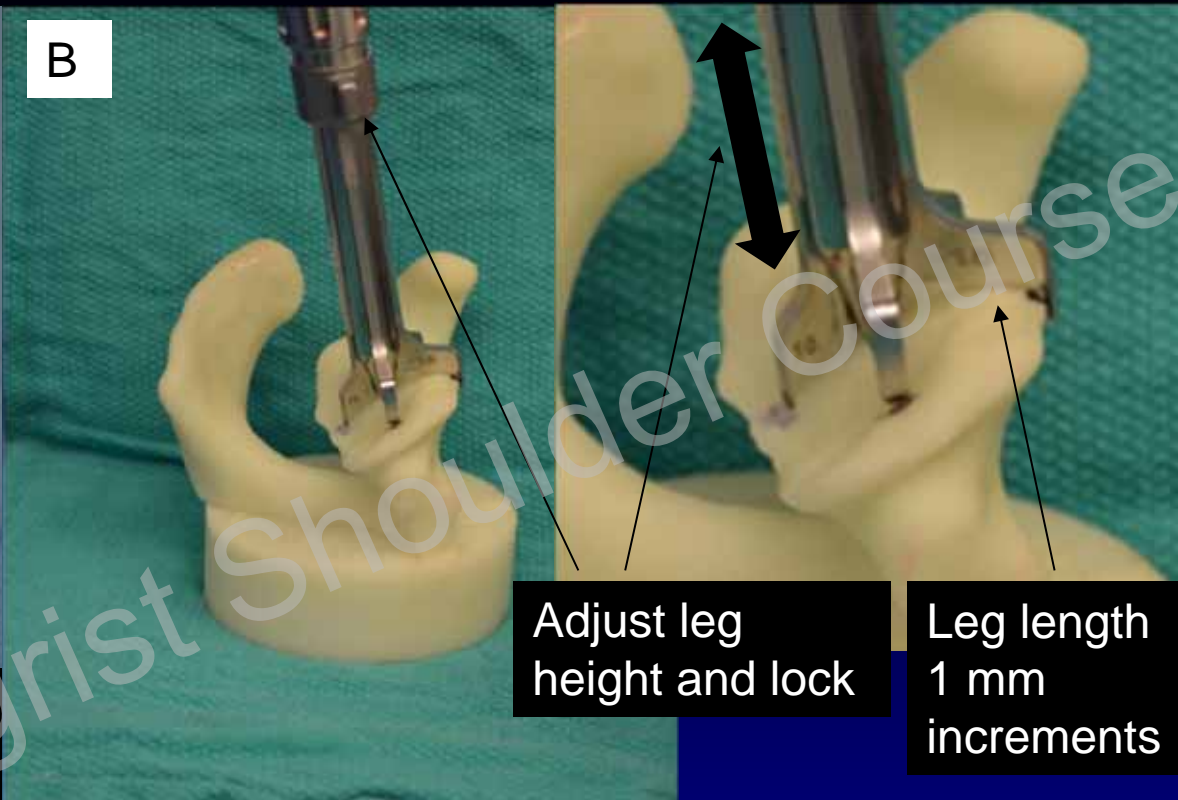
# IRI Plus 3D printed SmartBone

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# Reusable PSI adjusted by use of a surrogate model



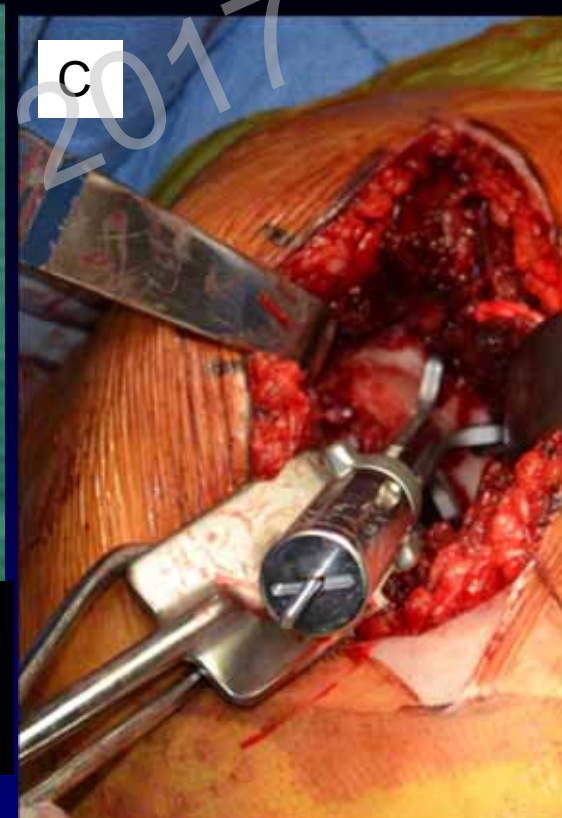
use surrogate model  
l by the software



Adjust leg height and lock

Leg length 1 mm increments

Single use surrogate model adjusting leg length and leg height

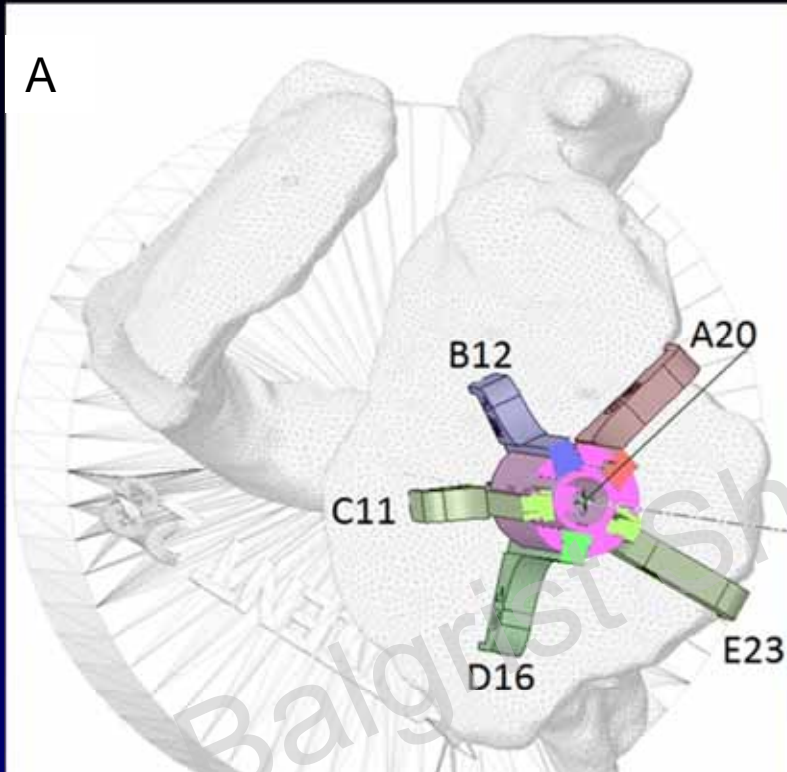


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# IRI plus Adjustable Base Reusable PSI

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# 4. Reusable PSI adjusted using a Reusable Surrogate Jig



Software defines both leg length and leg height A-E



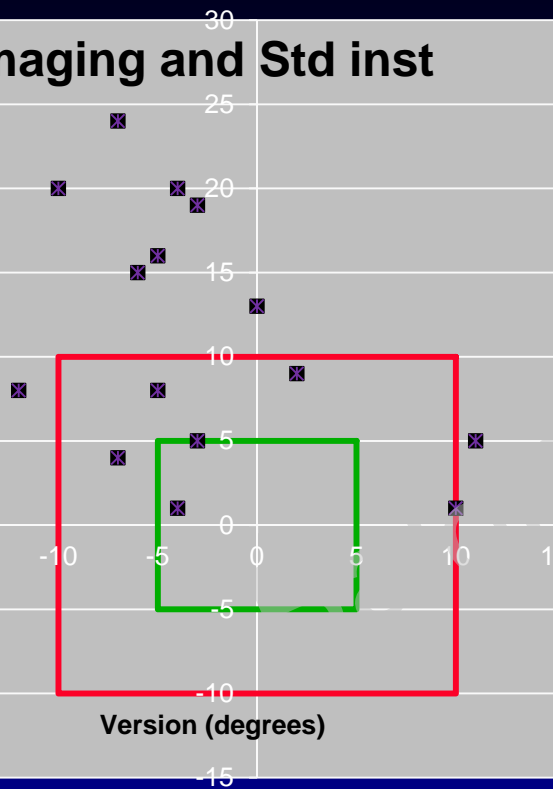
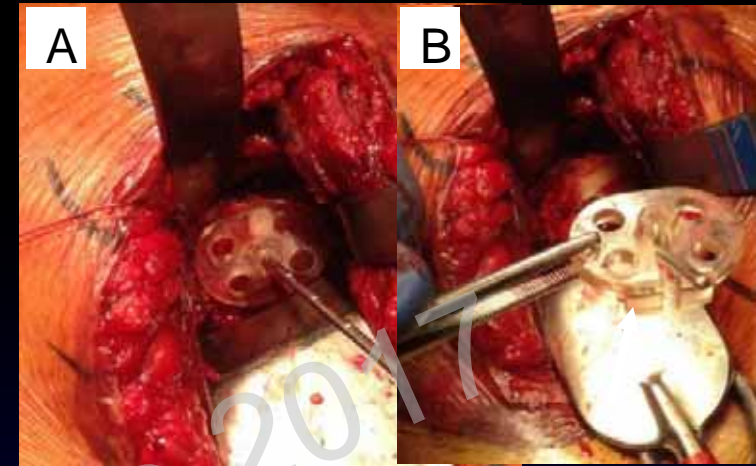
Adjustable base= glenoid  
Adjusting the leg height



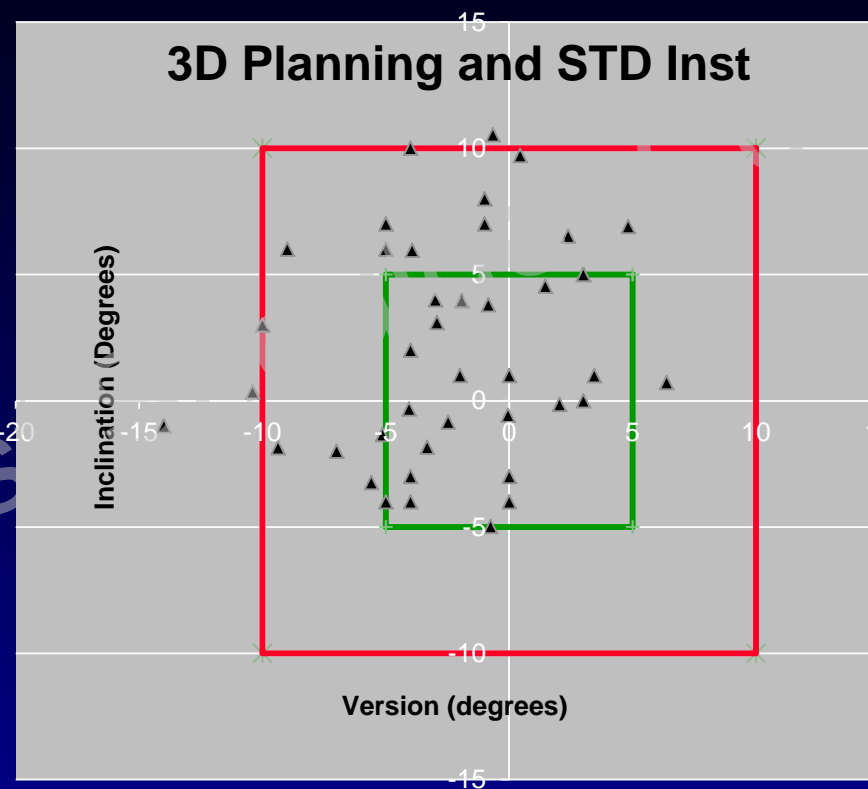
# RESULTS

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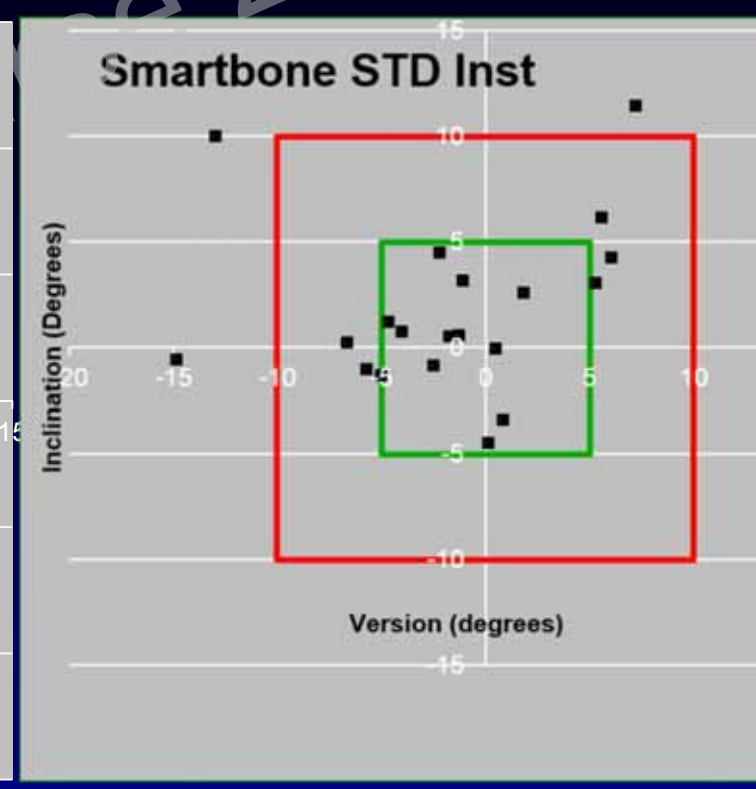
# 2D vs 3D Imaging with STD Instrumentation N= 62



10/17 outliers



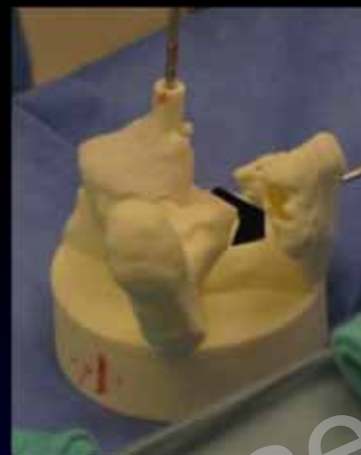
2/42 outliers



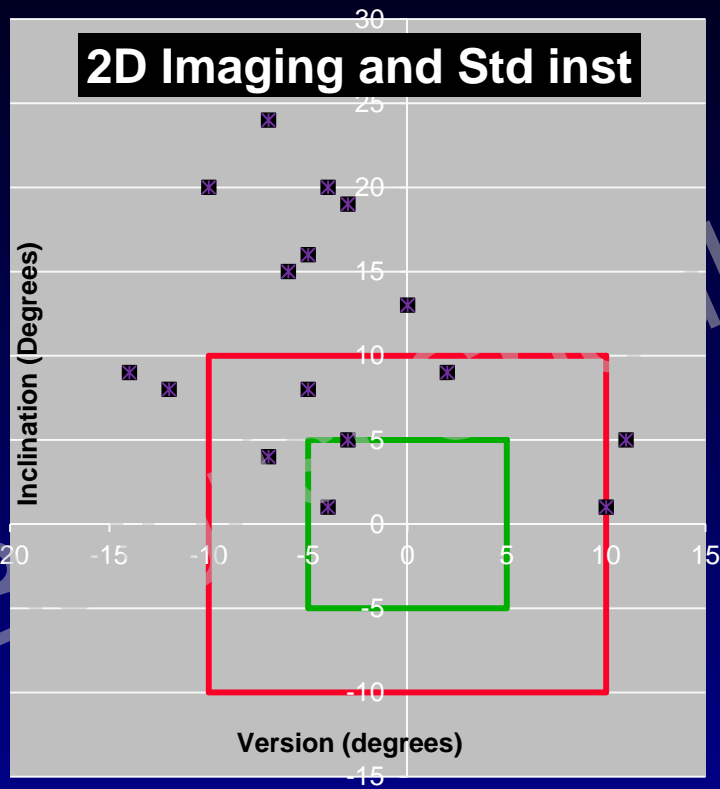
3/20 outliers



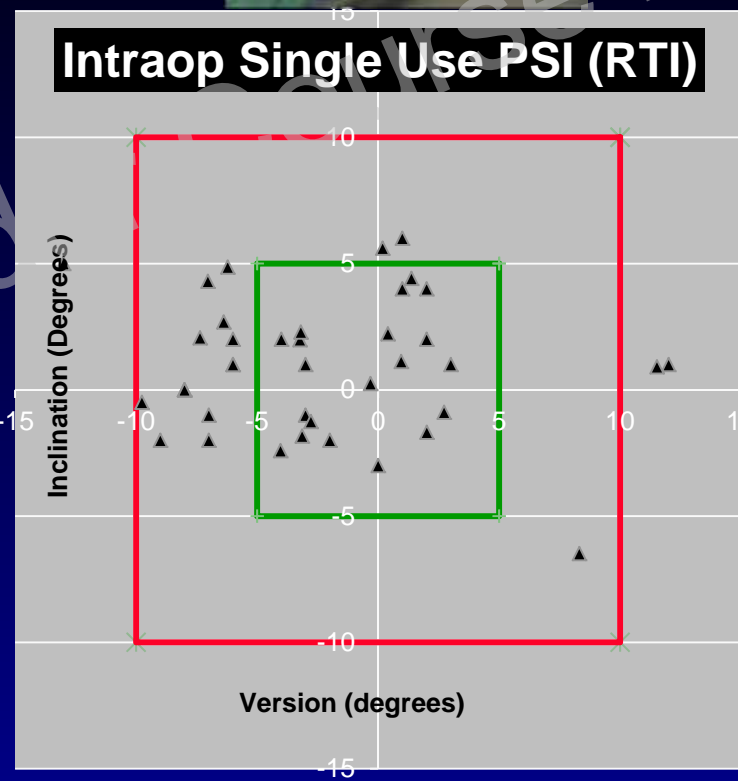
# 3D Imaging and Single Use PSI N = 37



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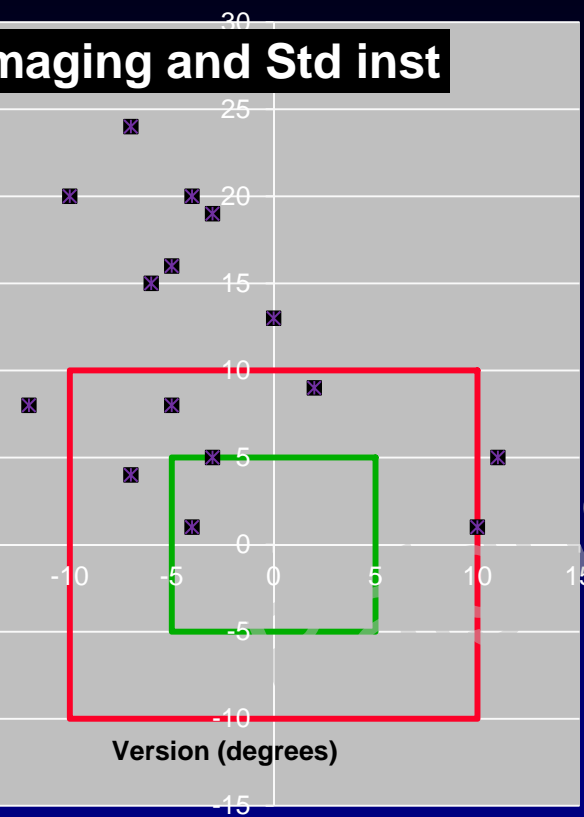


**10/17 outliers**

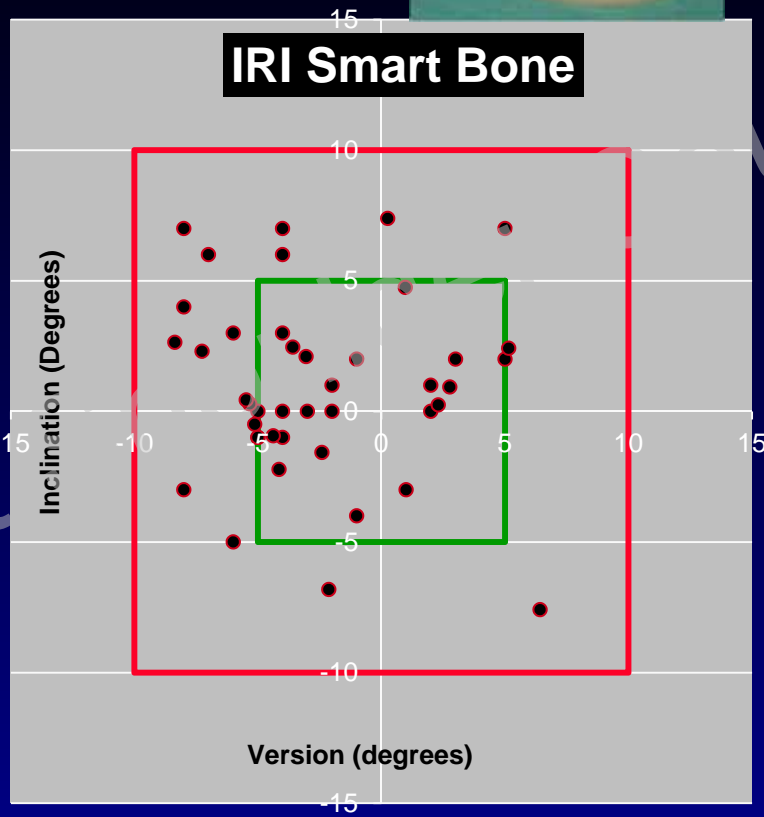


**2/37 outliers**

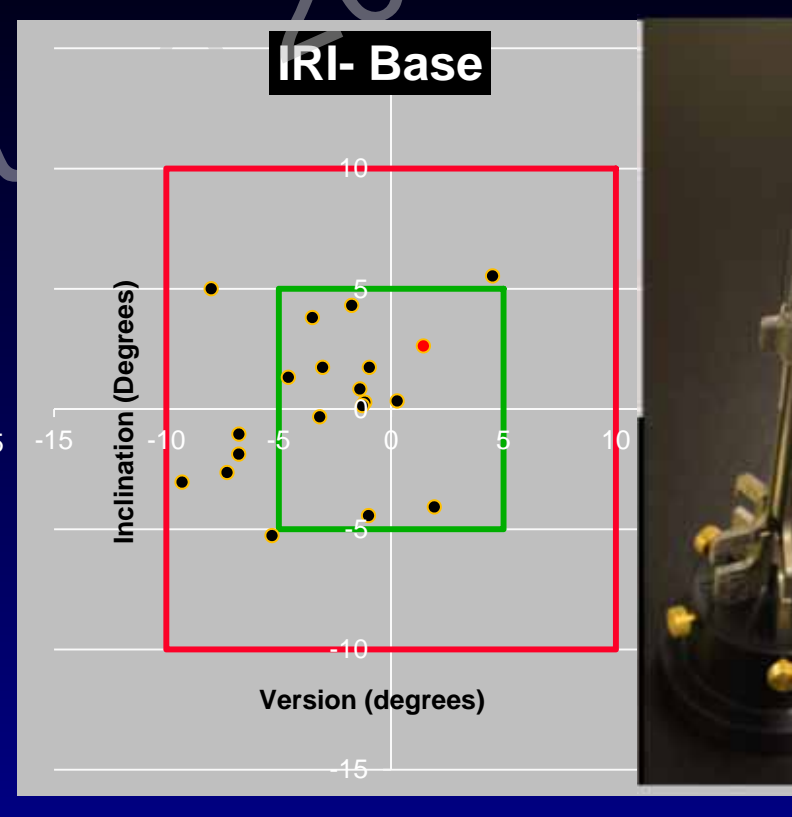
# Reusable PSI N= 58



10/17 outliers



0/38 outliers



0/20 outliers

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# The Challenges for Market Acceptance

- Cost of the technology
- Time to deliver the application
- Defining its clinical value

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# Conclusions

**3D planning and templating with any type of patient specific instrumentation shows an improvement in the precision**

**Compared to 2D imaging without templating and use of standard instrumentation**

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# Efficiencies of the Technology: Cost, Time and Ease of Use

## – Cost to deliver:

-  < \$200
-  \$ 200 - 800
-  > 800

## – Time to deliver:

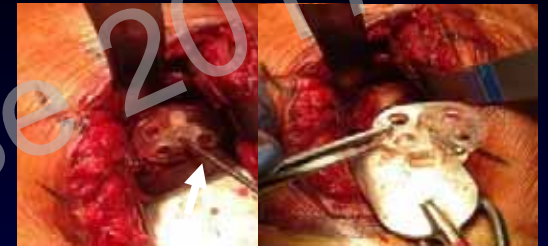
-  < 2 days
-  1-2 weeks
-  > 2 weeks

## – Ease of Use: Expertise required

-  Low Trainee
-  Medium Fellowship trained attending
-  Experienced Shoulder Surgeon

# Cost, Time and Use Considerations

- **Use of standard instrumentation: Thoughtful use of the 3D plan**
  - Cost: ●
  - Time to delivery: ●
  - Ease of use expertise required: ●
- **Single use patient specific instrumentation: 3D printing**
  - Pre surgical
  - Cost: ●
  - Time to delivery: ●
  - Ease of use, expertise required ●
  - **Intraoperative Real Time Instrumentation**
    - Cost: ●
    - Time to delivery: ●
    - Ease of use, expertise required: ●



# Cost and Time and Use Considerations

## ■ Reusable patient specific instrumentation: Customized from

### – Software to a 3D printed surrogate model and IRI

- Cost: ●
- Time to delivery ●
- Ease of use expertise required ●



### – Software to a adjustable and reusable surrogate jig

- Cost: ●
- Time to delivery: ●
- Ease of use expertise required: ●



# Conclusions

3D planning and templating with any type of patient specific instrumentation shows an improvement in the precision

Compared to 2D imaging without templating and use of standard instrumentation

The cost and time to delivery of the each type of technology needs to be considered when using one type of technology over another



# Thank You

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