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A Comparison of Onlay vs. Inlay Glenoid Prosthetic Design Survivorship Characteristics in Total Shoulder Arthroplasty

(Manuscript in-review)

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Inlay vs. Onlay: A Comparison of Two Glenoid Systems in Total Shoulder Arthroplasty

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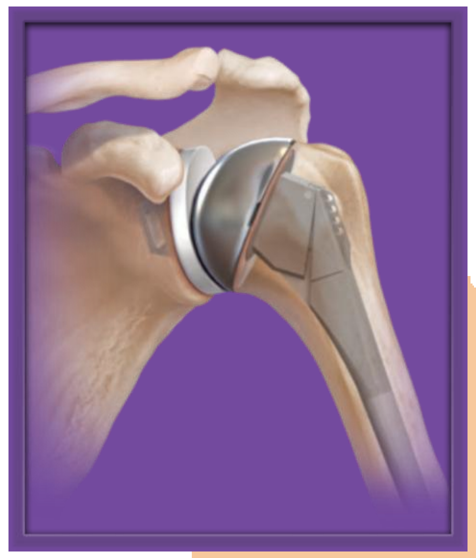
In collaboration with Clemson University and the Steadman Hawkins Clinic of the Carolinas

STATEMENT OF PURPOSE

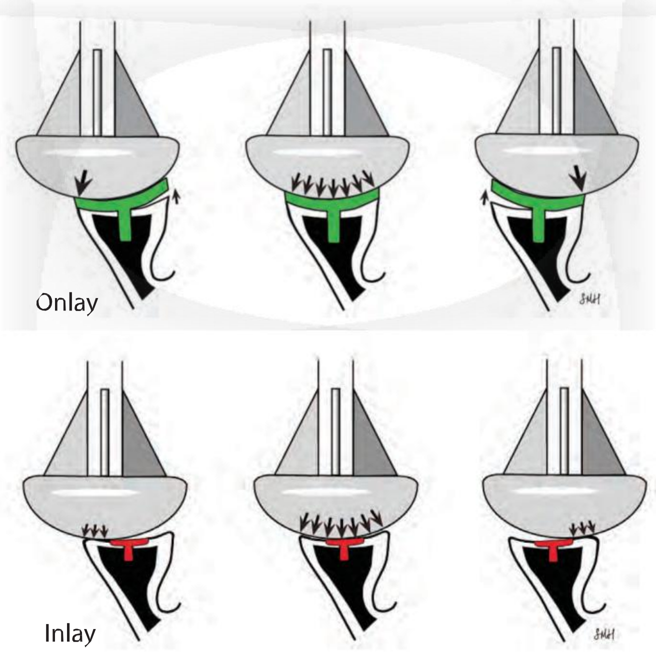


The glenohumeral joint is the most freely moving joint in the body.

The wide range of load and motion induced joint pathology can lead to a Total Shoulder Arthroplasty (TSA):

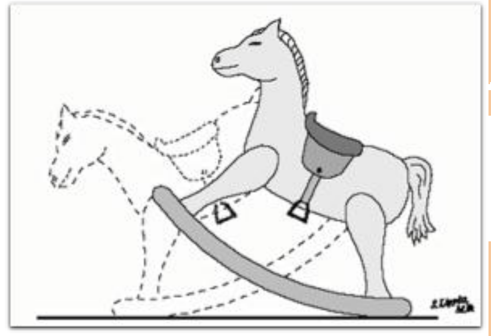
1. Humeral Component
2. Glenoid Component

The purpose is to examine the contact pressures and implant stability associated with fatigue loading of the glenoid inlay and onlay systems during physiologic loading and motion in a cadaveric model.



Hypothesis:

The glenoid inlay system will exhibit lower contact pressures, greater implant stability, and less rocking horse motion following fatigue loading than a standard onlay TSA system.



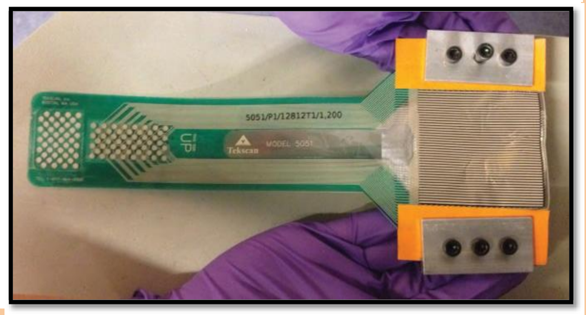
MATERIALS AND METHODS

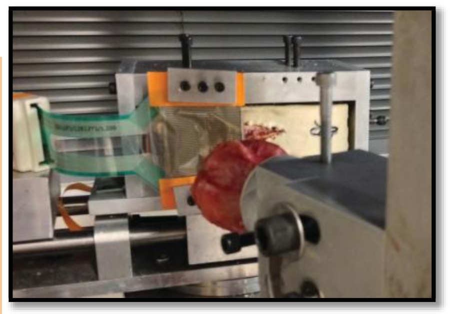
ONLAY SYSTEM

INLAY SYSTEM

Eight matched pair cadaveric shoulders (n=16) were dissected free of their musculature and each potted in aluminum alloy fixtures.

The glenoid was positioned parallel to the floor, with the humerus secured for testing in an abduction angle of 60°. Biomechanical testing was carried out using a materials testing machine that articulated the humerus with respect to the glenoid.





A flexible force sensor (K-scan Model 5051, Tekscan, Inc.) was reproducibly positioned in the glenohumeral joint to record the contact pressure distribution and area.

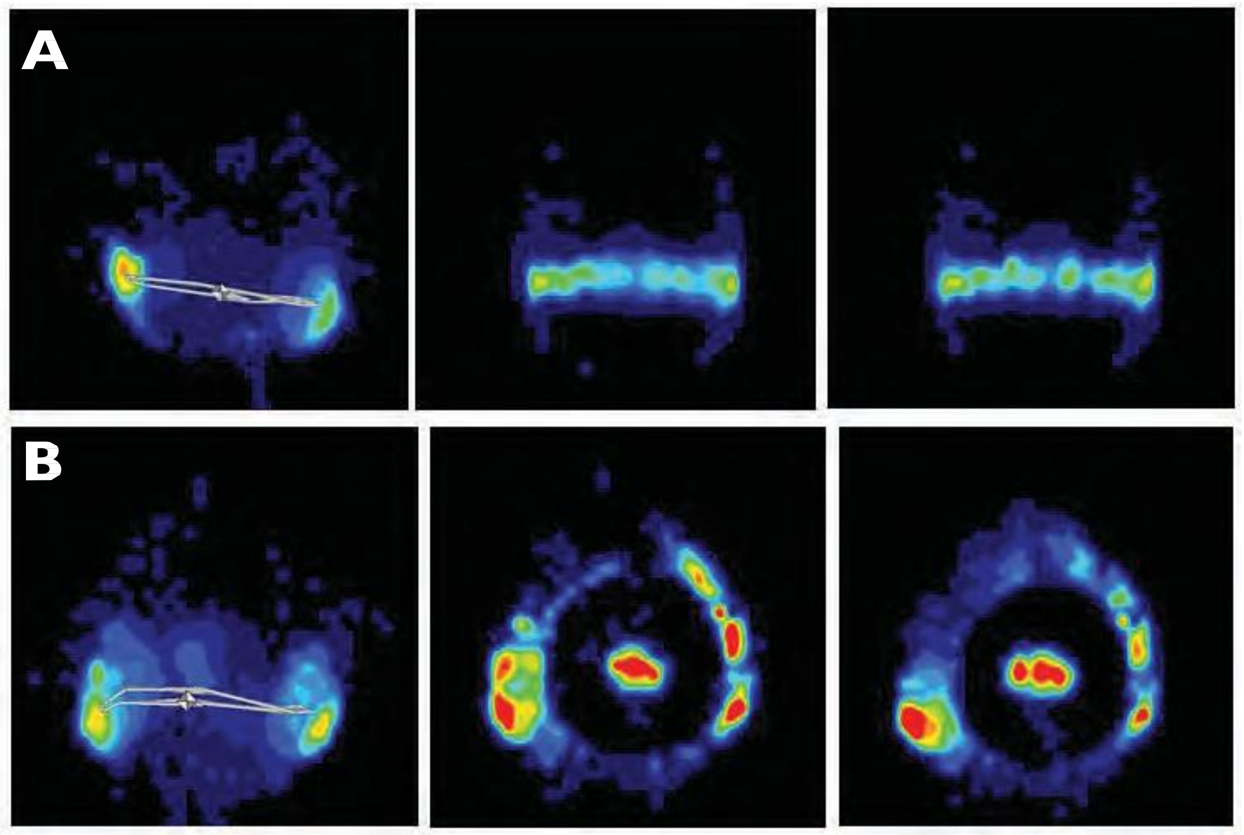
A ± 5 mm displacement-controlled anterior/posterior humeral motion was induced to produce glenoid edge loading while an 88.9 N compressive joint load was applied across the joint.

TSAs were then performed on all shoulders followed by post implantation CT, with one of each matched pair being implanted with the onlay glenoid implant (Turon system - DJO Surgical) and the other with the inlay glenoid implant (HemiCAP system - Arthrosurface).

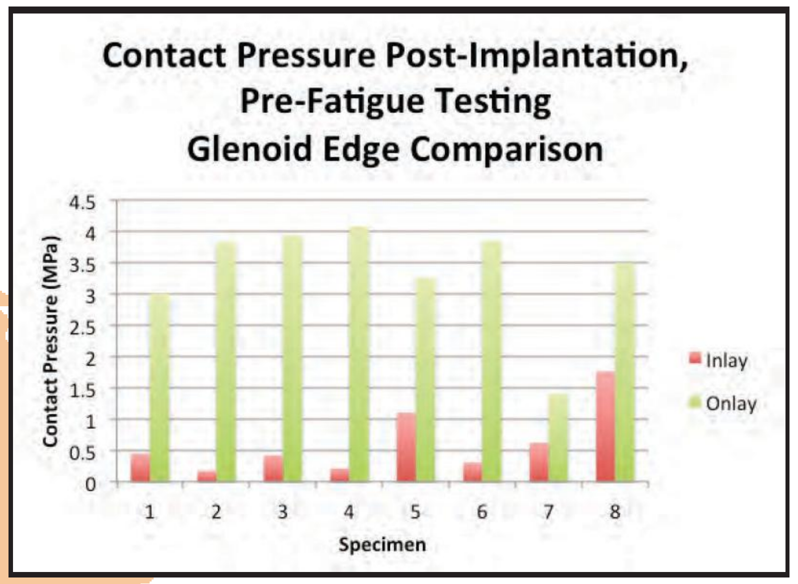
Biomechanical testing was repeated, followed by ± 5 mm of anterior/posterior cyclic fatigue testing with a joint compressive load of 333.6 N. This was performed to 4000 cycles or until clinical loosening was observed, followed by a final CT image.

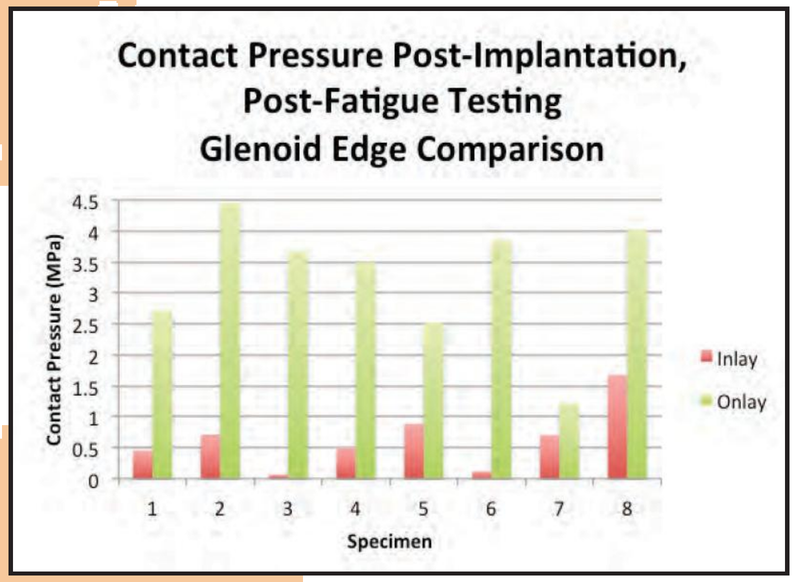
Differences in measures of contact area, center of pressures, clinical implant stability and bone patency were statistically assessed between implant designs and over fatigue testing time.

RESULTS and DISCUSSION



A: Specimen tracking shown pre-implantation (left), post-implantation of an onlay implant, pre-fatigue testing (middle), and post-implantation post-fatigue testing (right)
B: Specimen tracking shown pre-implantation (left), post-implantation of an inlay implant, pre-fatigue testing (middle), and post-implantation post-fatigue testing (right)





The specimens implanted with onlay implants experienced much higher pressures on the edge of the glenoid.

These pressures were diverted to a more central location and native tissue experienced most of the edge loading with the inlay implant.

This is a potential explanation for the dramatic difference in visible loosening seen during fatigue testing, as shown in the chart below.

Each specimen implanted with an onlay implant experienced visible loosening in less than half the cycles that the inlay experienced without any signs of loosening.

Specimen	1	2	3	4	5	6	7	8
Onlay	875	1372	1463	772	1838	n/a**	814	749
Inlay	4000*	4000*	4000*	4000*	4000*	4000*	4000*	4000*

*Specimen was fatigued 4000 cycles and did not loosen, however testing was stopped.

CONCLUSIONS

The inlay implant resisted visible loosening in all fatigue testing of 4000 cycles, however all onlays showed loosening in under 2000 cycles

The pressure was higher on both implants (polyethylene) than the native tissue

The change in location of pressure during eccentric loading to a more central area provided better stability to the inlay because the pressure was diverted to the native tissue on the glenoid edge

REFERENCES

Matsen FA 3rd, Lippitt SB. Shoulder surgery: principles and procedures. Philadelphia: Saunders; 2004. Principles of glenoid arthroplasty; p 508.

ACKNOWLEDGMENTS

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