Mid-Flexion Stability of Total Knee Arthroplasty: A Stress-X-Ray Comparison of Posterior-Stabilized vs Medial-Stabilized vs Condylar-Stabilizing Designs

David F. Scott, MD, Amy A. Hellie, BS Spokane Joint Replacement Center, Spokane, WA, USA

Introduction

- Mid-flexion stability is believed to be an important factor influencing successful clinical outcomes in total knee arthroplasty.

- In many PS knee systems, the post does not engage the cam until 60° or more of flexion.

- Highly-conforming polyethylene insert designs were introduced as an alternative to post and cam posterior-stabilizing knees (PS).

- Two more conforming designs include deep-dish (CS, or Condylar-stabilizing) and Medial-Stabilized (MS or "medial pivot").

Methods

- Stryker Triathlon CS
- Stryker Triathlon PS
- Medacta GMK Sphere

- 99 Subjects more than one year postop. with a well-functioning total knee, min. ROM 0-120°.

- AP stability of the knee was evaluated quantitatively using anterior and posterior stress radiographs in the lateral position.

- Standardized 150 Newton force was applied anteriorly and posteriorly with the knee in 45° and 90° of flexion. (Figure 1)

- Measurements of displacement were made by tracing lines along the posterior margin of the tibial component and the posterior edge of the femoral component, which were perpendicular to the tibial baseplate. (Figure 3)

- Statistics: ANOVA with Tukey post-hoc

Results

- Demographic data (no significant differences) (Table 1)

- In 45° of flexion, the MS group demonstrated the least total anterior/posterior displacement and the CS group the greatest, all three groups differed statistically (Figure 2, p ≤ 0.05).

- In 90° of flexion, the MS group and PS groups were similar, and demonstrated less total anterior/posterior displacement than the CS group (Figure 2, p ≤ 0.05).

- The results of all the clinical outcomes measures, range of motion, and long-axis x-ray alignment were similar statistically. (Table 2)

Figure 1: Telos Stress device and setup

Table 1: Demographic Data

Variable	PS (n=28)	MS (n=34)	CS (n=37)	P-value
Men/Women (n)	13/15	20/14	18/19	NS
Mean age at surgery (yrs)	64.5	63.6	63.3	NS
men	63.6	62.3	64.3	NS
women	65.3	65.4	62.3	NS
Mean BMI	32.2	30	26.3	NS

Table 2. Outcomes Data/ROM/Alignment

	MS (n = 34)	PS (n = 28)	CS (n = 37)	P-value
Forgotten Joint Score	56.9	62.6	68.6	NS
KSS (Pain/Motion)	98.3	97.4	95.3	NS
KSS (Function)	95.6	90.0	87.7	NS
LEAS	11.03	10.64	10.51	NS
Avg. Flexion	127.2	127.5	126.2	NS
Avg. Extension	0.21	0.18	0.24	NS
Anatomic Tibio-femoral angle (° Valgus)	6.1	5.2	6.1	NS

Figure 2: 45° and 90° Laxity Data

AP Laxity 45° Flexion @ 150 N — Sphere 3.71, PS 7.33, CS 12.44 (mm Total Laxity)

AP Laxity 90° Flexion @ 150 N — Sphere 3.94, PS 3.54, CS 9.74 (mm Total Laxity)

Figure 3: Radiographic Examples (45°)

CS Anterior Displacement

CS Posterior Displacement

PS Anterior Displacement

PS Posterior Displacement

Figure 3: Radiographic Examples (45°) con't

Sphere Anterior Displacement
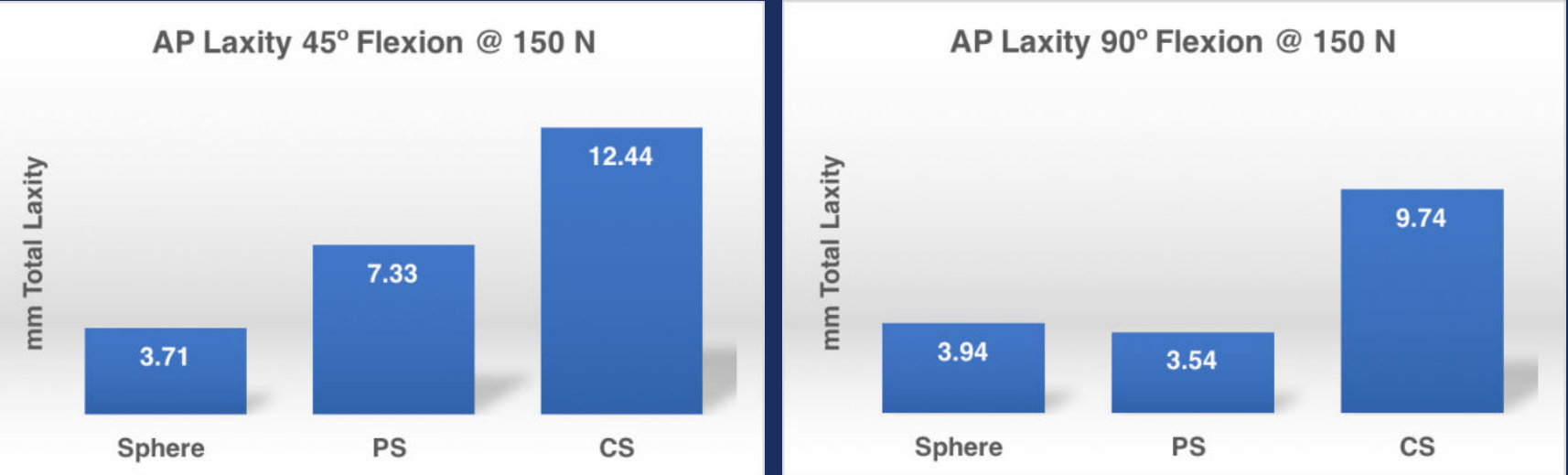
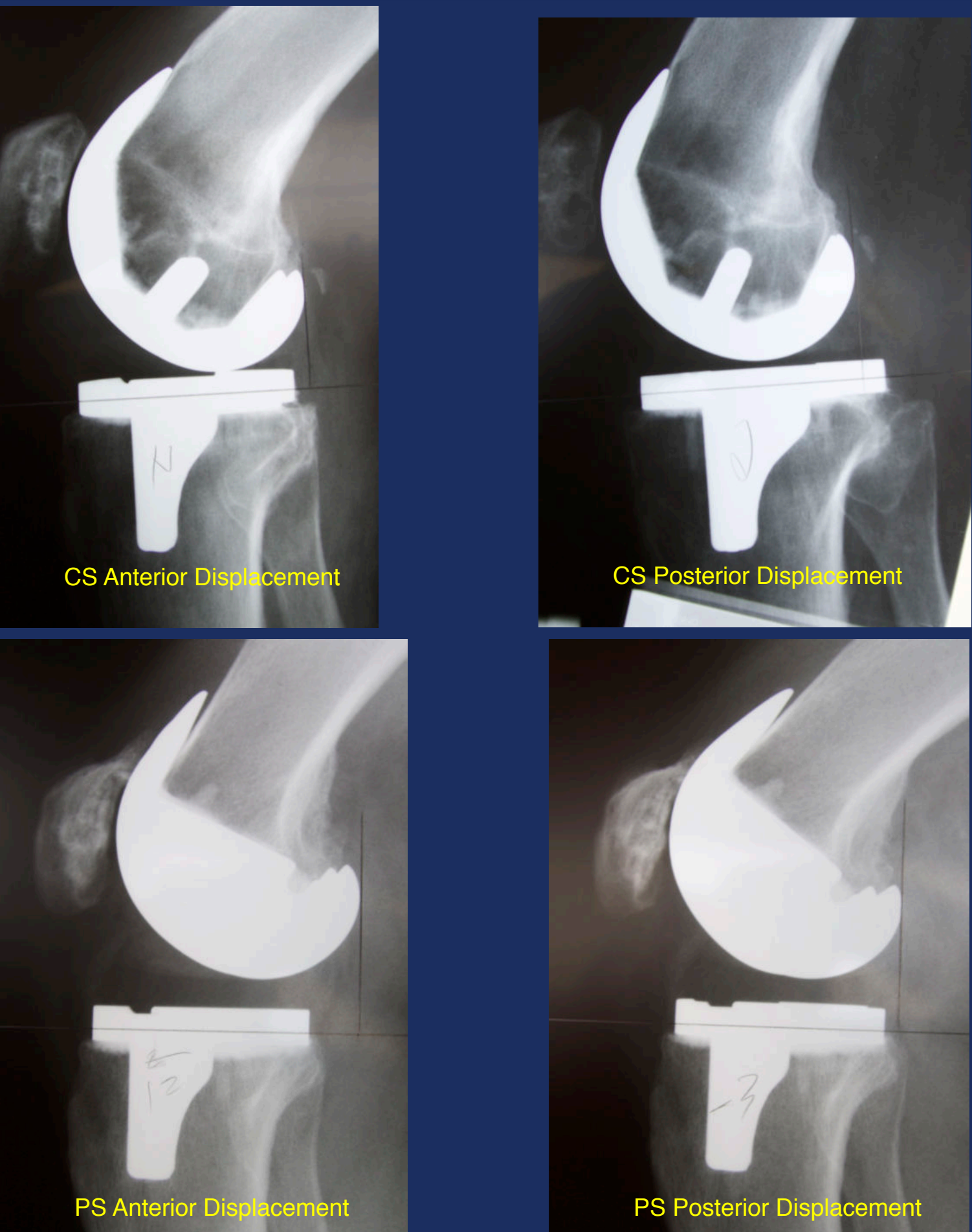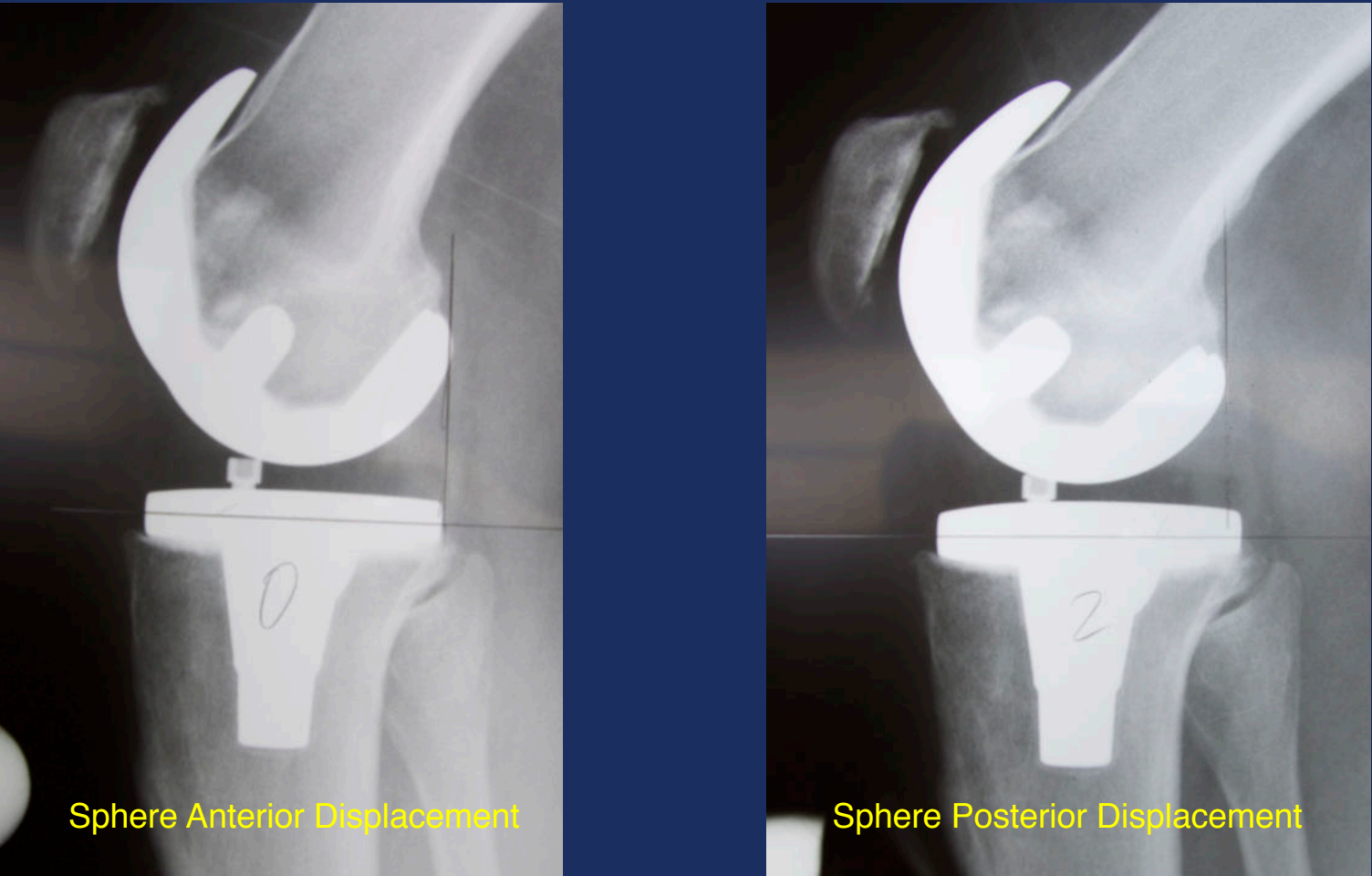Sphere Posterior Displacement

Conclusion

- The clinical outcomes, ROM, and long-axis x-ray alignment of the three groups were equivalent statistically.

- In 45° of flexion:
    - CS was the least stable and
    - Medial-stabilized the most stable (p<0.05).

- In 90° of flexion:
    - CS was the least stable (p<0.05) and
    - the other 2 groups were equivalent in stability (statistically non-significant).

- **The Sphere group provides the best mid-flexion stability**

- Weaknesses of this study include:
    - retrospective, non-randomized design
    - CS & PS groups 5-8 yrs postop, Sphere 1-2 yrs postop

Disclosures

The author discloses:

- Research funding: Stryker Orthopedics, Omni LifeScience, Medacta, Microport, Regenesis Biomedical, Myoscience.
- Consulting: Medacta, Omni LifeScience
- Editorial Board (reviewer): Journal of Arthroplasty