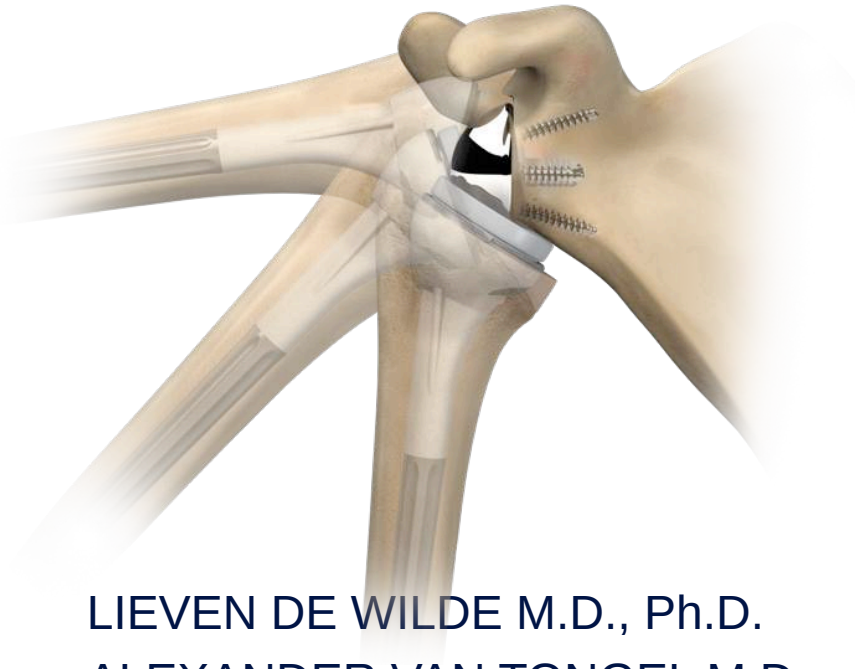
Schoudergroep TerBrugGen

Reverse Total Shoulder Arthroplasty
Which innovations are helpful?



LIEVEN DE WILDE M.D., Ph.D.
ALEXANDER VAN TONGEL M.D.

AZ St Jan Bruges UZ Ghent Zorgsaam Terneuzen

Conflict of interest

LDW certifies that he has a commercial association (consultancies, royalties, patent/ licensing arrangements, etc) that might pose a conflict of interest in connection with the presentation (DePuy-Synthes).

Many Brands available (29 - 2014)

Many Brands available (29)

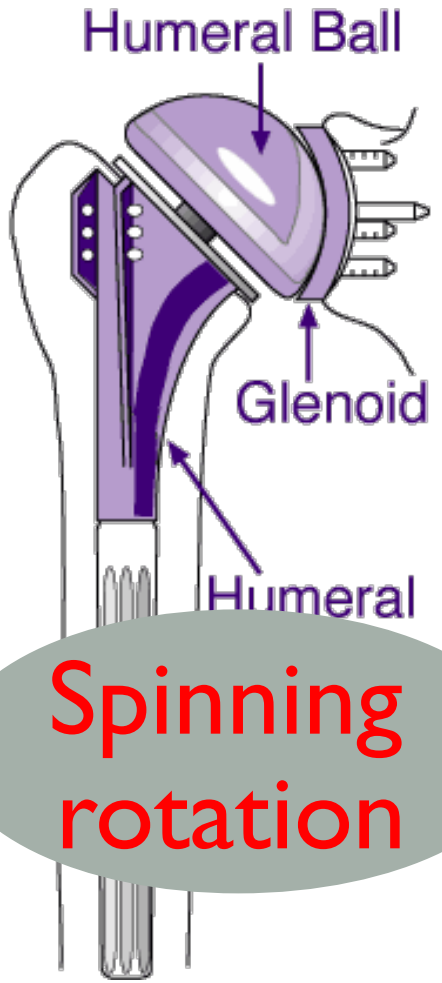
1. all have an identical reverse polarity principle.

2. Different prosthetic design features.

Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.

Hinged rotation



Spinning rotation

Reverse Polarity Principle

Anatomical joint is a spinning rotation around a central axis

≈ Revolving door

Reverse Polarity Principle

Anatomical joint is a spinning rotation around a central axis

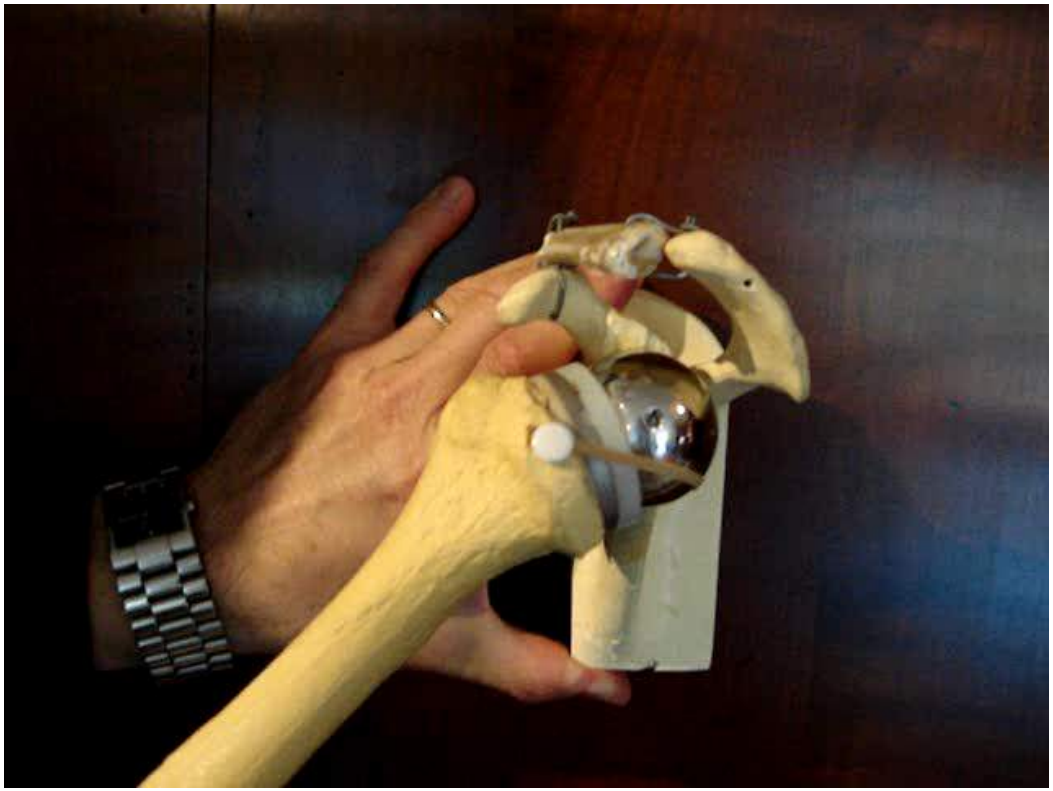
Reverse Polarity Principle

Reverse polarity is a hinging rotation around a lateral axis

≈ Conventional door

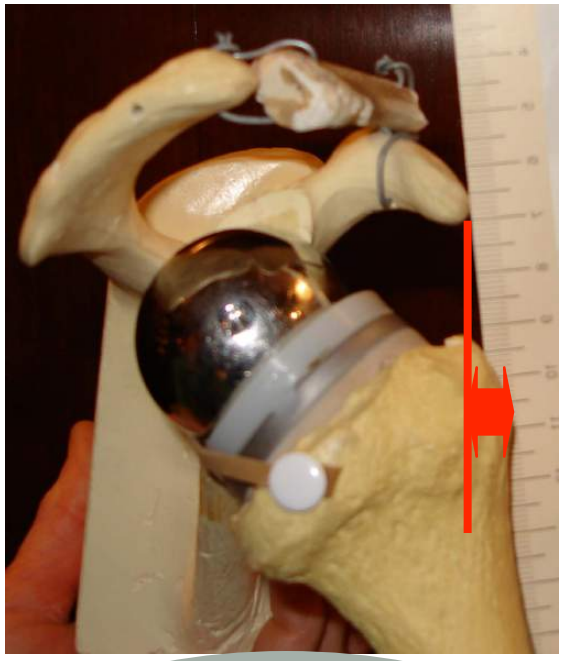
Reverse Polarity Principle

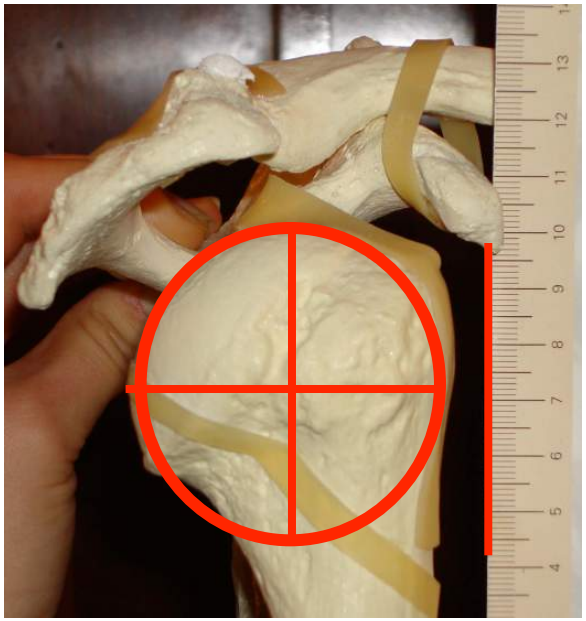
Reverse polarity is a hinging rotation around a lateral axis



Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.





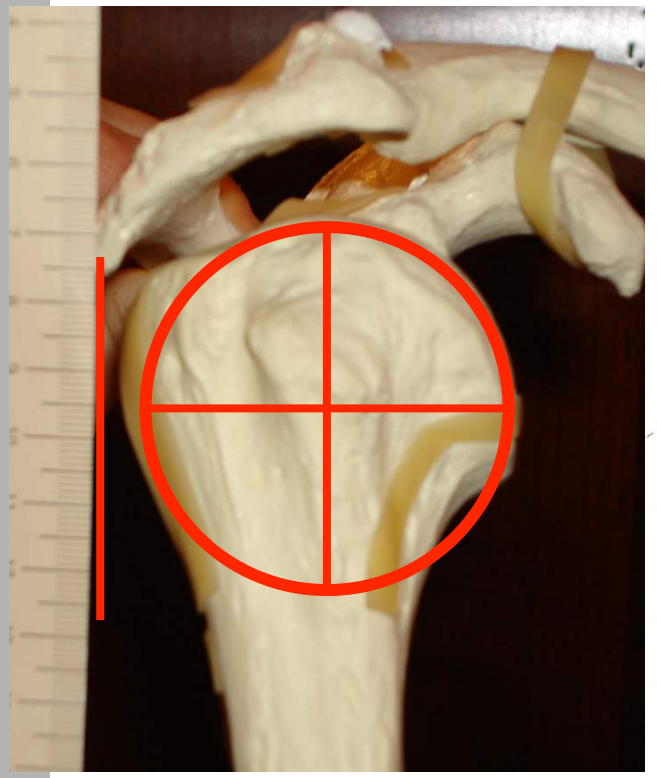
Hinging rotation

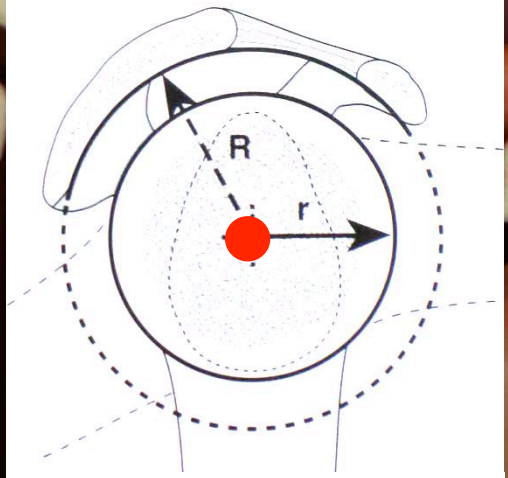
Spinning rotation

Reverse Polarity Principle

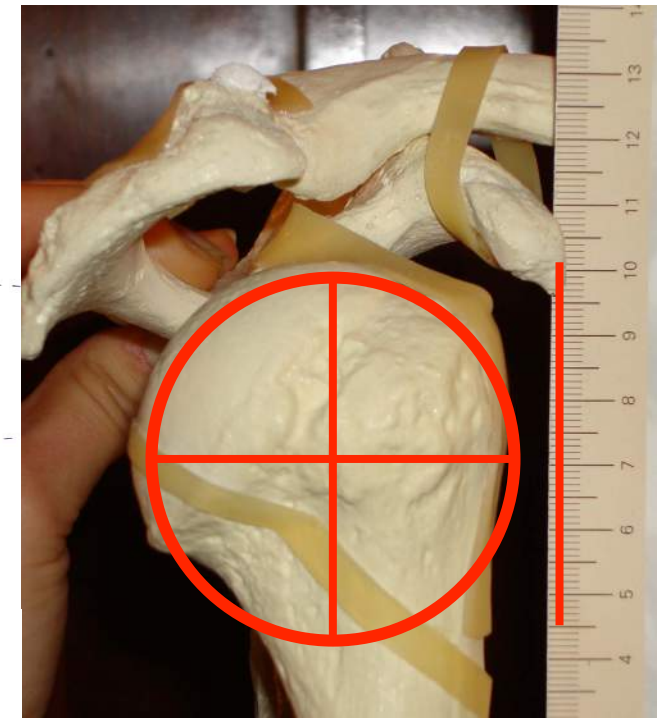
Biomechanical difference RSTA <> TSP.

The biomechanical difference: a spinning rotation → minimal articular (rotational) room !





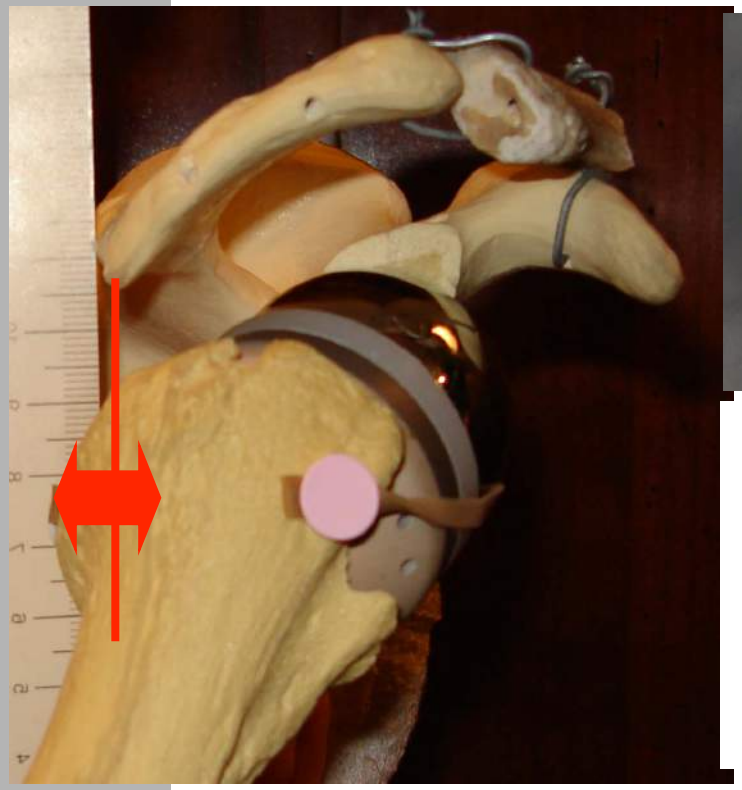
Concentric spheres concept of Matsen

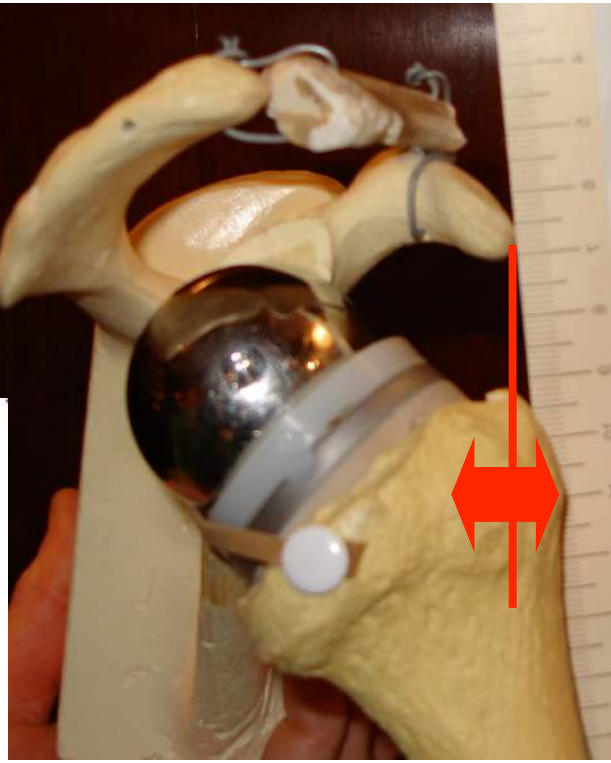


Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.

The hinged rotation needs more rotational room → extra articular (rotational) room needed → no room = no movement

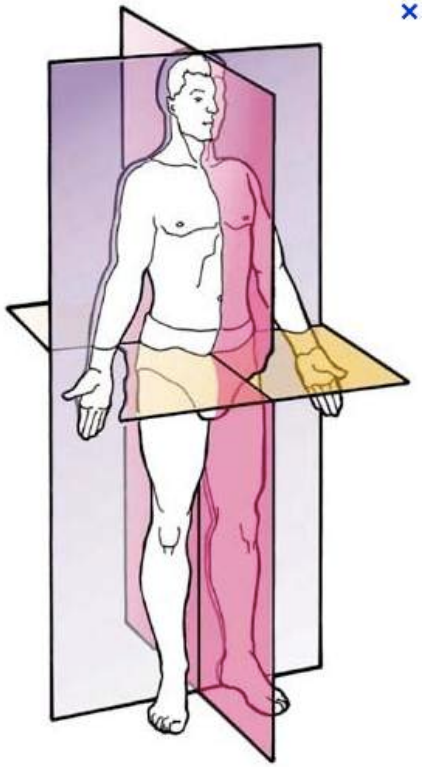


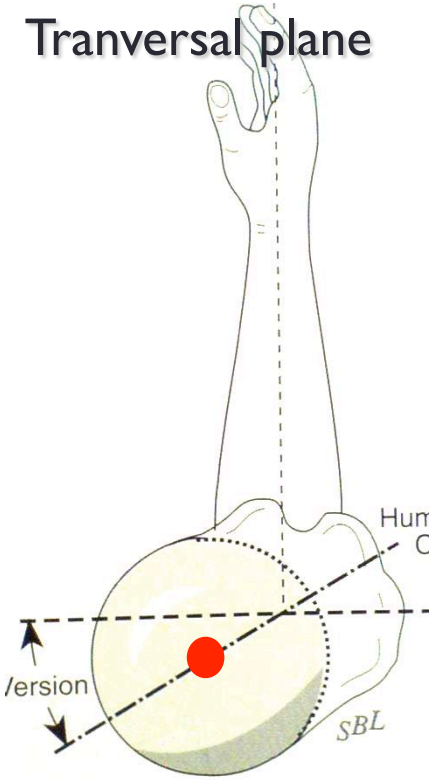


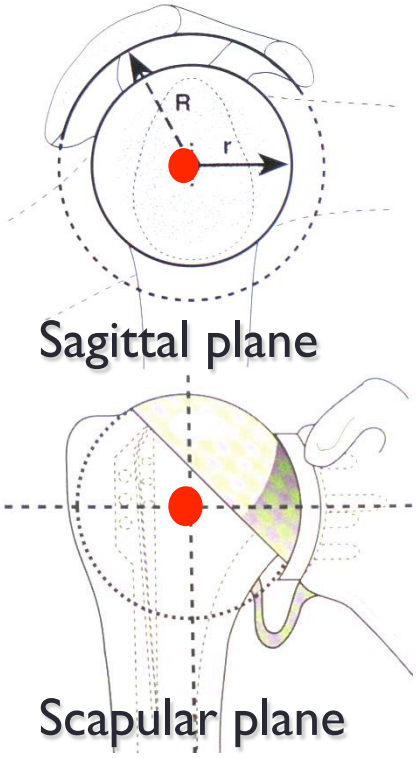
Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.

Anatomical: Center of rotation must be restored very accurately in three dimensions: !



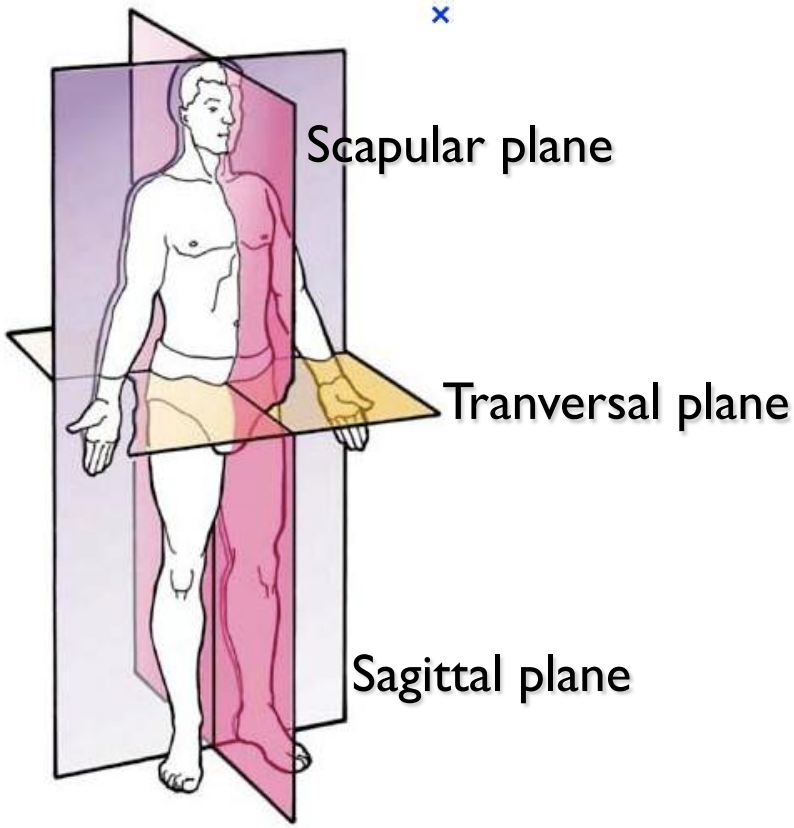




Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.

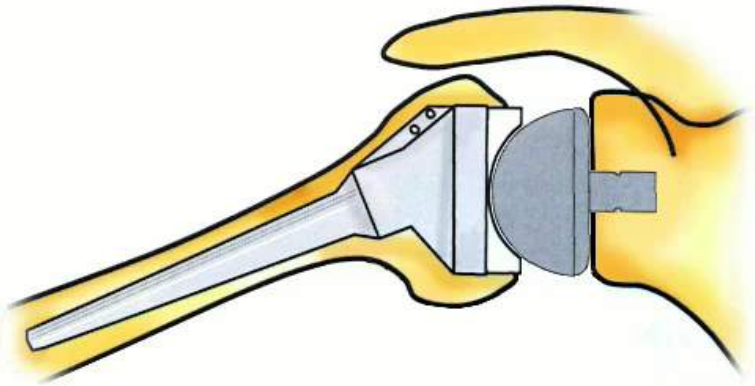
Reverse: Extra room is needed in three dimensions!

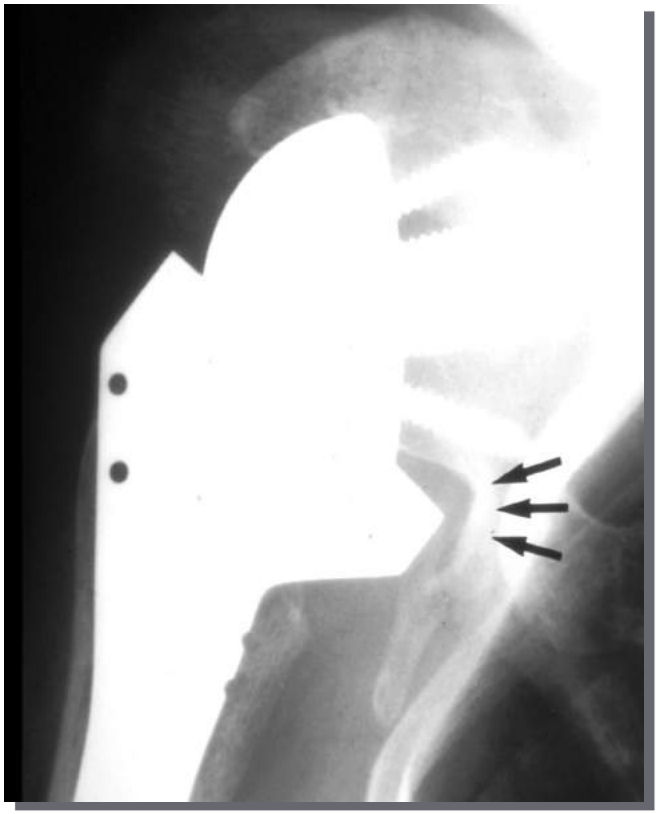


Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.

If no extra room in scapular plane → scapular notching!





Courtesy of P. Boileau.

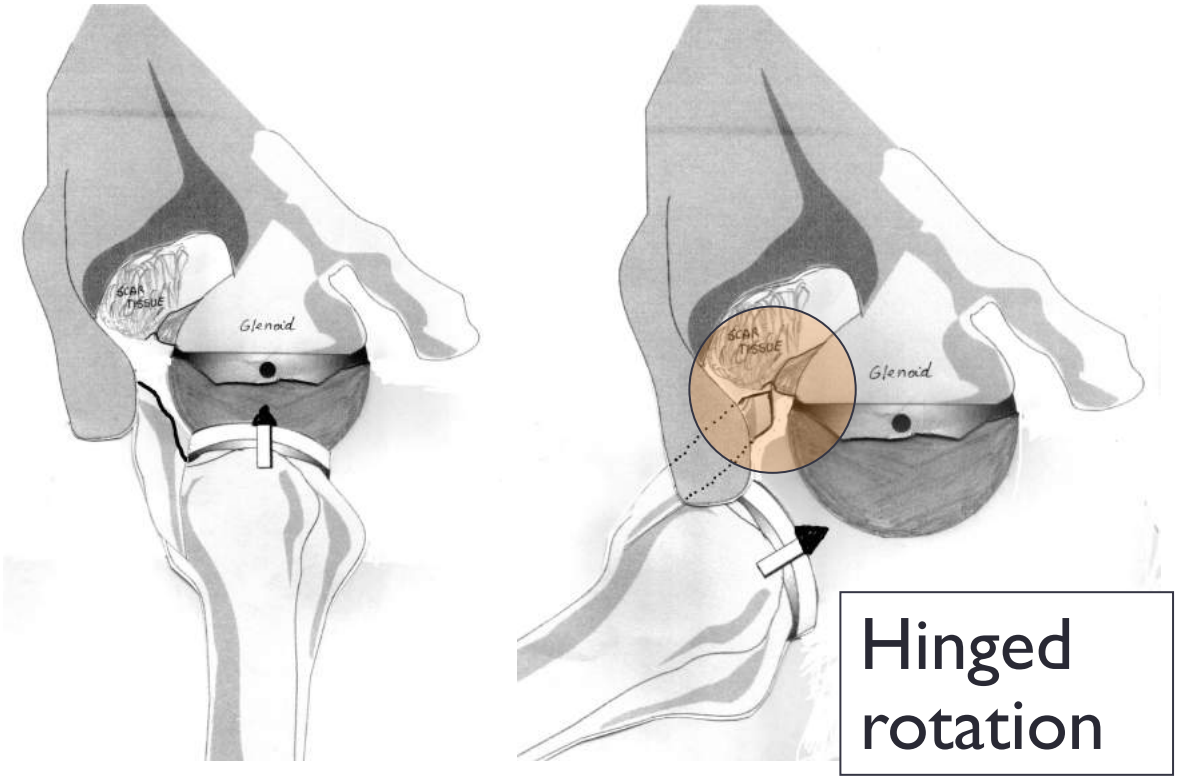
Reverse Polarity Principle

Biomechanical difference RSTA <> TSP.

Extra room needed in transversal plane → limitation of external/internal rotation!

Reverse Polarity Principle

Extra room needed in transversal plane of the body → limitation of external/internal rotation



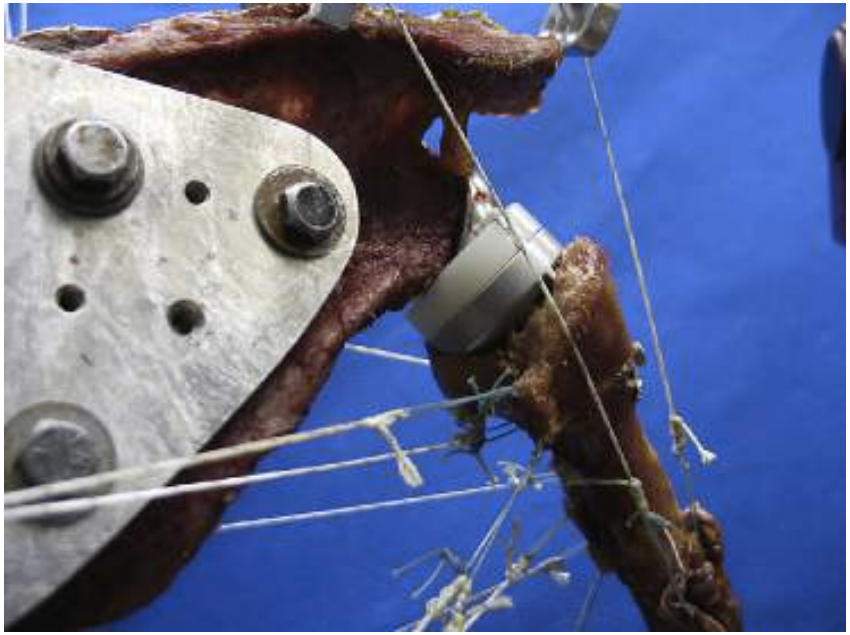
Hinged rotation

A hinged rotation and dislocation can occur if bony malunions of the tuberosities bump against the glenoid and or remaining fibrous tissue !

Reverse Polarity Principle

Extra room needed in transversal plane of the body → limitation of external/internal rotation

especially in > 30° abduction

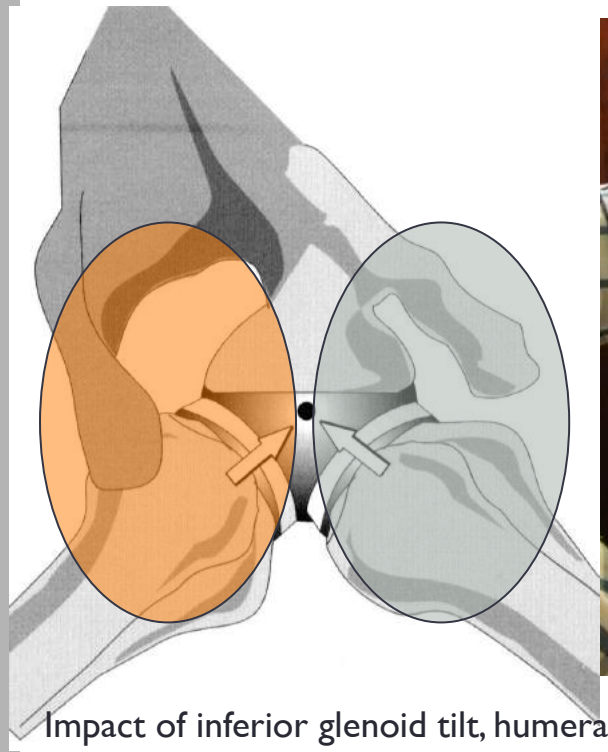


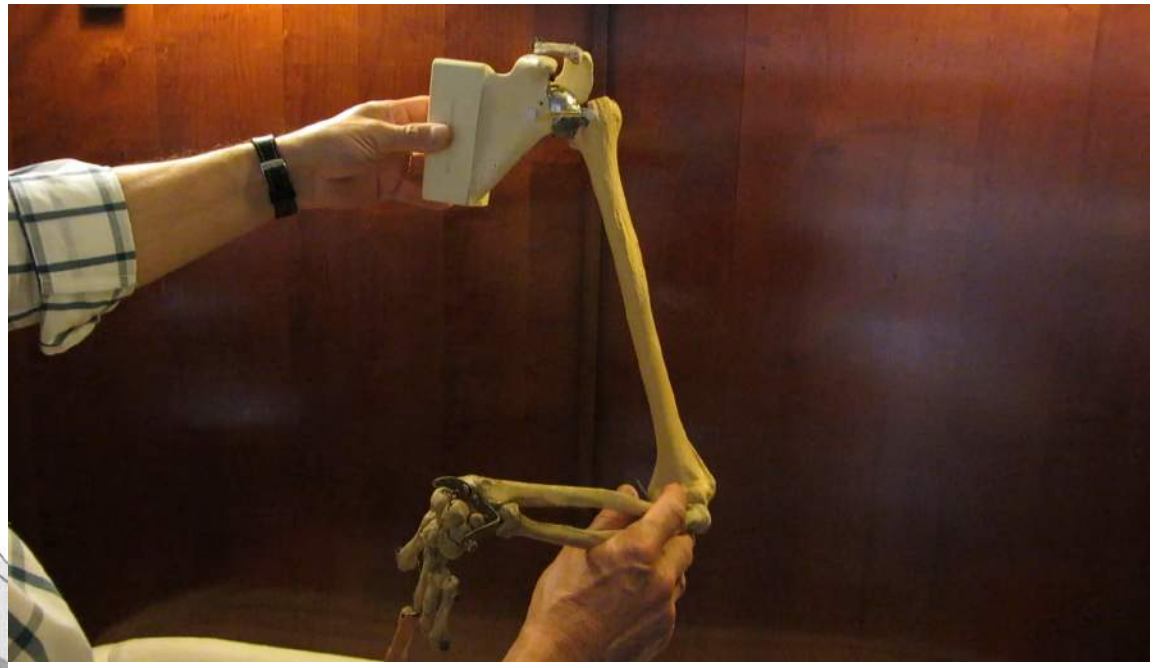
Effect of humeral component version on impingement in reverse total shoulder arthroplasty. Stephenson DR, Oh JH, McGarry MH, Rick Hatch GF 3rd, Lee TQ. J Shoulder Elbow Surg. 2011 Jun;20(4):652-8. doi: 10.1016/j.jse.2010.08.020. Epub 2010 Dec 8.

Reverse Polarity Principle

Surgical techniques and prosthetic designs, which result in a more lateral humeral position increase deltoid wrapping and better tensioning of the anterior and posterior shoulder muscles.

Cave: extra room needed in transversal plane of the body → limitation of external/internal rotation.





Impact of inferior glenoid tilt, humeral retroversion, bone grafting, and design parameters on muscle length and deltoid wrapping in reverse shoulder arthroplasty. Roche CP, Diep P, Hamilton M, Crosby LA, Flurin PH, Wright TW, Zuckerman JD, Routman HD. Bull Hosp Jt Dis (2013). 2013;71(4):284-93.

2. What's the design difference ?

Baseplate convex or flat, +/- coating ?
Baseplate keeled or vault, enforcement possible ?
Baseplate with a central plot, screw (short, long)
Baseplate screws (locking and/or angulation angulated mechanism) ?
Baseplate with small or big Morse taper ?

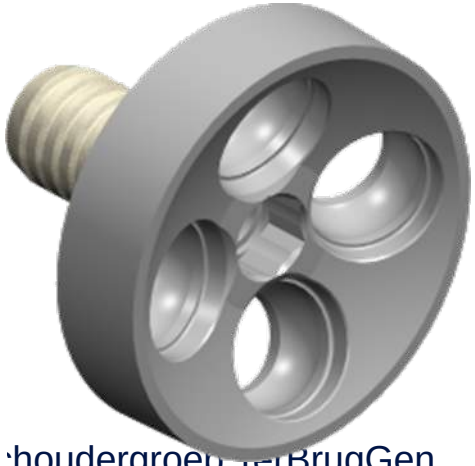
Glenosphere sizes, eccentricity or not ?
Glenosphere (half a sphere or more or less) ?

PE-inter changeability
Horseshoe-like, dial-able ?

Stem or stemless ?
Angulation varus/valgus – 155° ?
Posterior offset or not ?
Cemented, cementless ?

Conversion from anatomical to reverse ?
Glenohumeral relationship ?

Baseplate

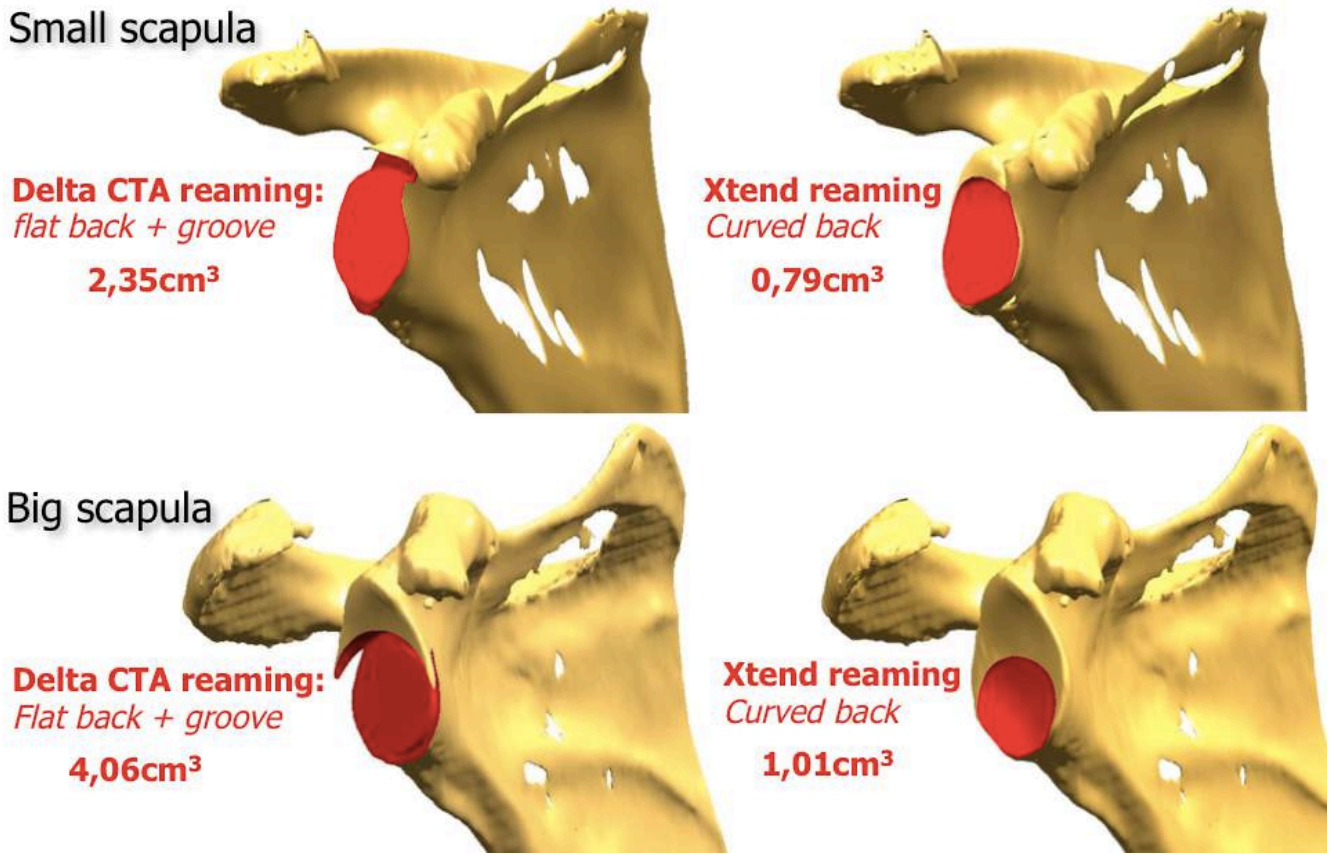


Pin guided reaming is as accurate as nipple guided reaming

A glenoid reaming study: how accurate are current reaming techniques?Karelse A, Leuridan S, Van Tongel A, Piepers IM, Debeer P, De Wilde LF. J Shoulder Elbow Surg. 2014 Aug;23(8):1120-7. doi: 10.1016/j.jse.2013.11.023.

Smaller radius of the reamer eases reaming

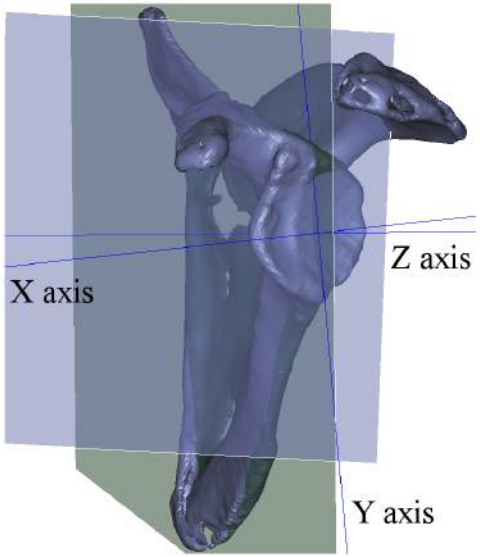
Flat reaming removes more bone than convex reaming in uniconcave glenoids

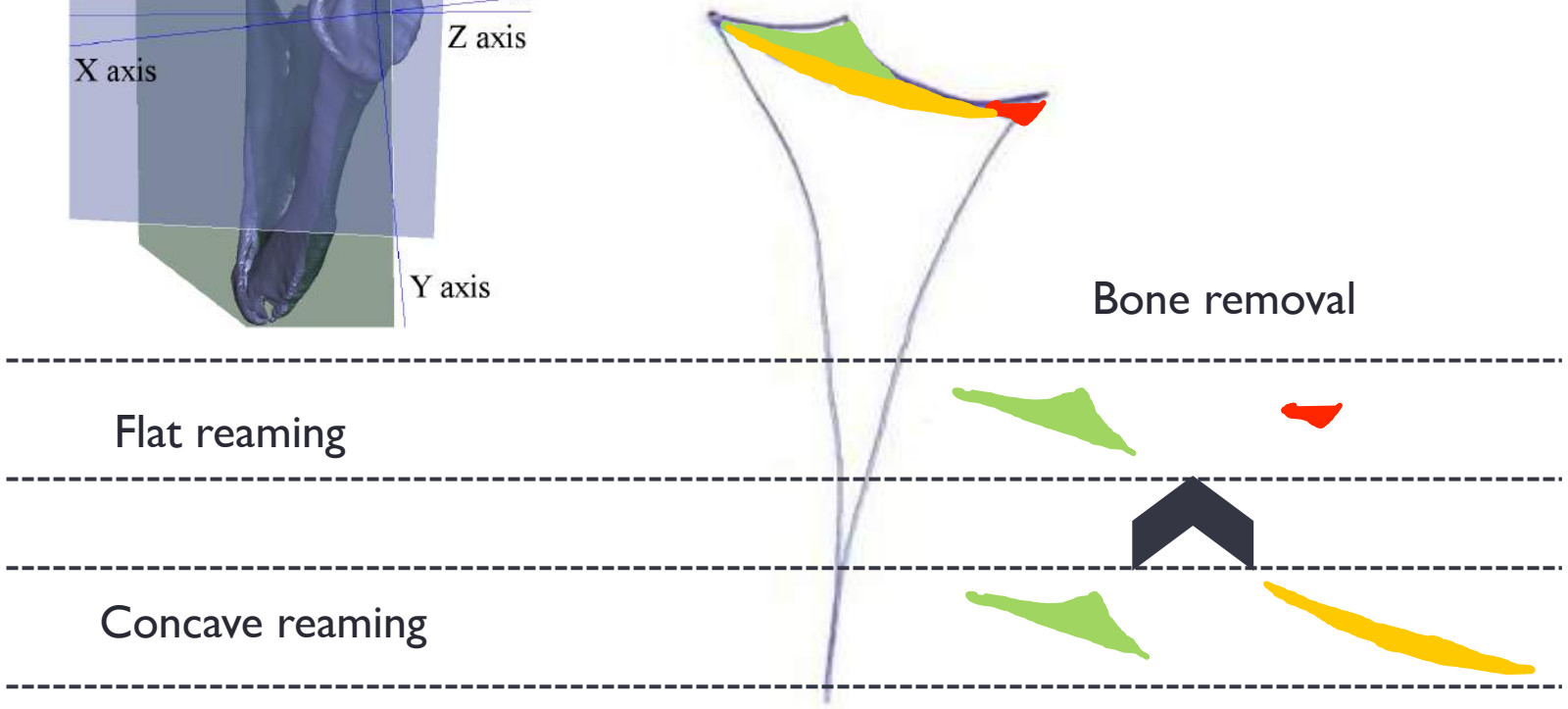


The more bone reamed away the more the bone weakens.

Does glenoid baseplate geometry affect its fixation in reverse shoulder arthroplasty? James J, Huffman KR, Werner FW, Sutton LG, Nanavati VN. J Shoulder Elbow Surg. 2012 Jul;21(7):917-24. doi: 10.1016/j.jse.2011.04.017. Epub 2011 Jul 20.

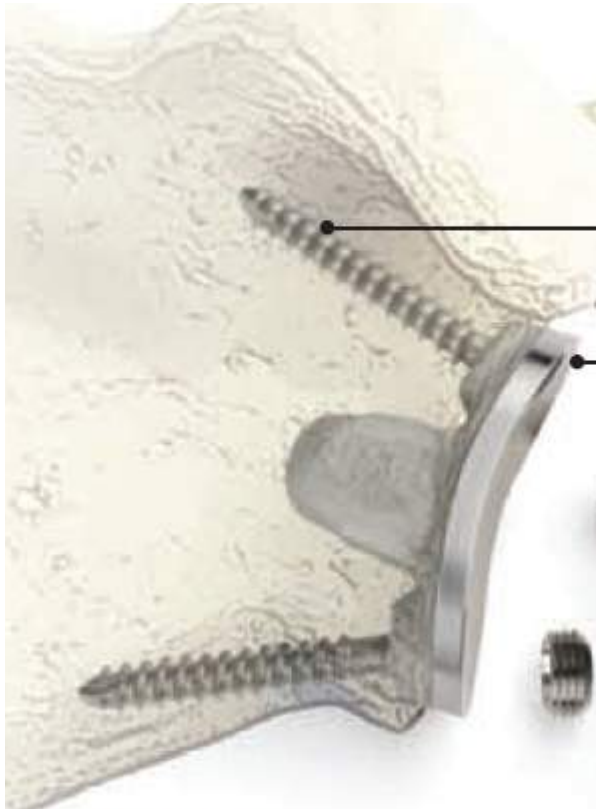
Flat reaming remove less bone than convex reaming in biconcave glenoids



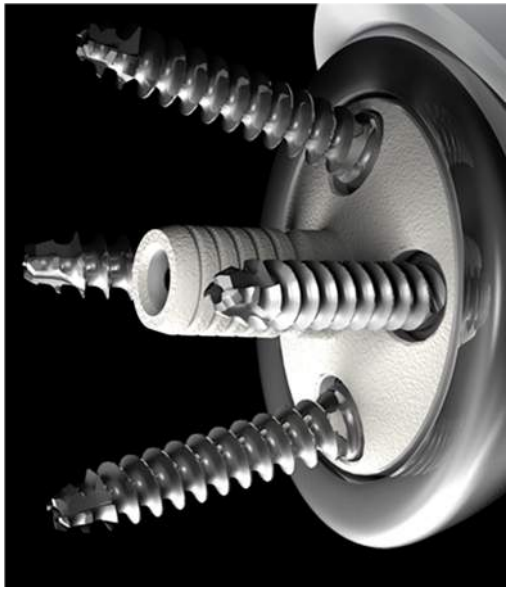


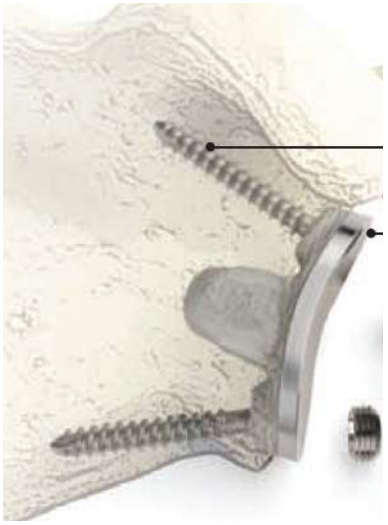
Consequences of reaming with flat and convex reamers for bone volume and surface area of the glenoid. A Karelse, A Vantongel, P Debeer, S Leuridan, L De Wilde. Int Orthopedics. 2014, In press.

Keeled, (ec)centric pegged baseplate

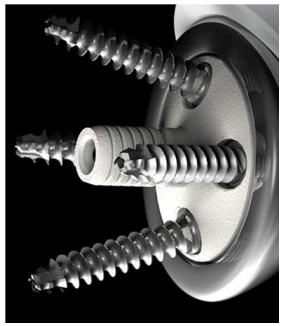


Circular or oval baseplate





Circular or oval baseplate

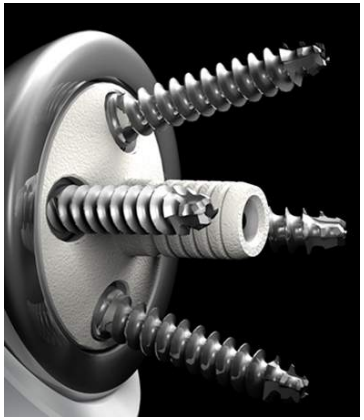


- Baseplate shape and size affects fixation strength more than backside geometry.
- The 25 × 34 mm oval baseplates showed better fixation characteristics than their 25 mm circular counterparts.
- No difference in fixation between flat-back and curved-back baseplates.

Reverse shoulder glenoid baseplate fixation: a comparison of flat-back versus curved-back designs and oval versus circular designs with 2 different offset glenospheres. Roche CP, Stroud NJ, Flurin PH, Wright TW, Zuckerman JD, DiPaola MJ. J Shoulder Elbow Surg. 2014 Sep;23(9):1388-94. doi: 10.1016/j.jse.2014.01.050. Epub 2014 Apr 13.

Central peg/screw : Long, short or cut-off possibility, extra rough-blasted, trabecular metal, hollow, two pegs, conical…

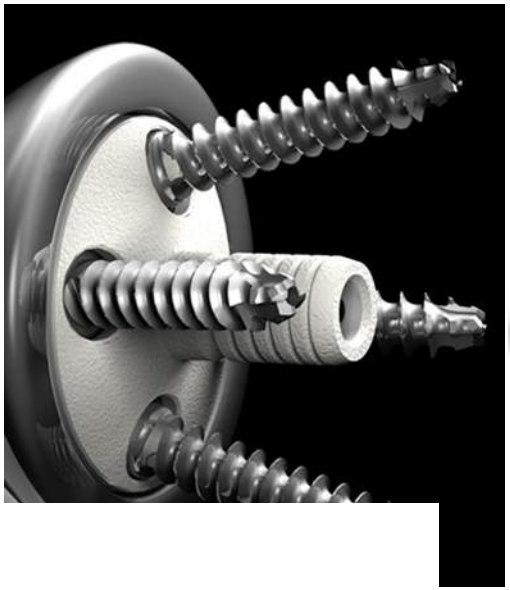
Conical central screw and big keel are improving fixation most.

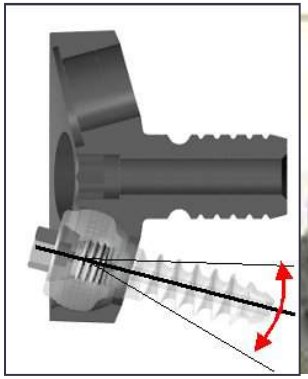


-An experimental glenoid rim strain analysis for an improved reverse anatomy shoulder implant fixation. Mordecai SC, Lambert SM, Meswania JM, Blunn GW, Bayley IL, Taylor SJ. J Orthop Res. 2012 Jun;30(6):998-1003. doi: 10.1002/jor.22015. Epub 2011 Nov 16.

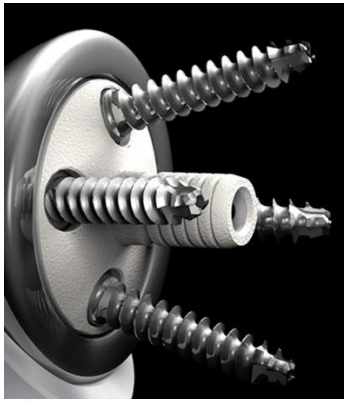
-Primary stability in reversed-anatomy glenoid components. Hopkins AR, Hansen UN. Proc Inst Mech Eng H. 2009 Oct;223(7):805-12.

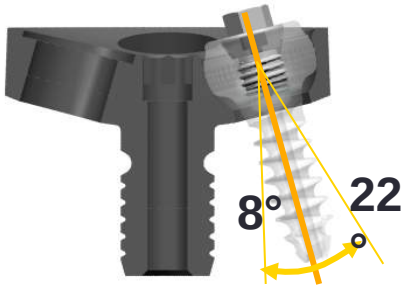
Adjustable angulated stable screws <>
Non angulated stable screws





Number of screws in baseplate ? 2, 3, 4 or more ? (2 is OK!)





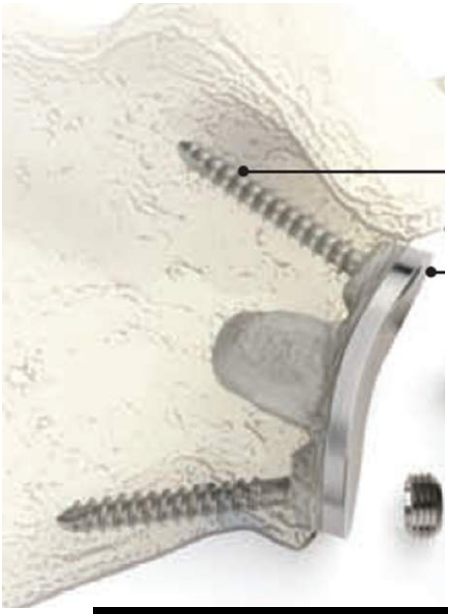
-2 screws are OK

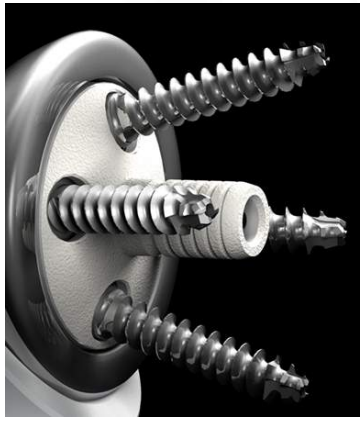
-if not, a long posterior screw in the scapular spine improves initial strength.

-Reverse shoulder arthroplasty glenoid fixation: is there a benefit in using four instead of two screws? James J, Allison MA, Werner FW, McBride DE, Basu NN, Sutton LG, Nanavati VN. J Shoulder Elbow Surg. 2013 Aug;22(8): 1030-6. doi: 10.1016/j.jse.2012.11.006. Epub 2013 Jan 23.

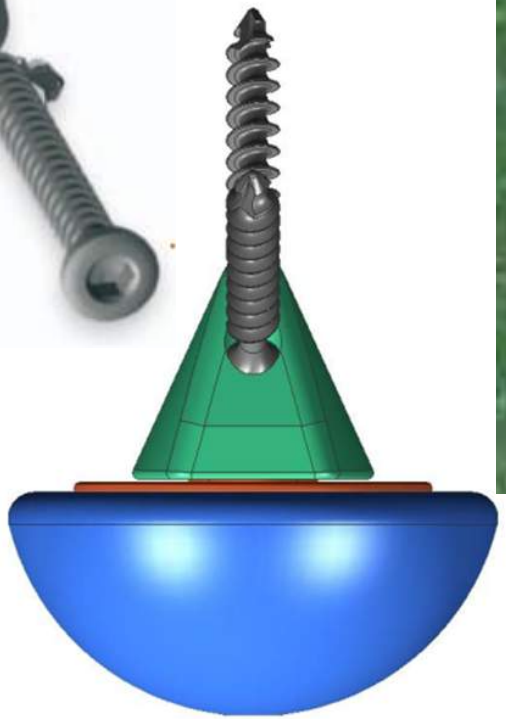
-Reverse glenoid component fixation: is a posterior screw necessary? Hoenig MP, Loeffler B, Brown S, Peindl R, Fleischli J, Connor P, D'Alessandro D. J Shoulder Elbow Surg. 2010 Jun;19(4):544-9. doi: 10.1016/j.jse. 2009.10.006. Epub 2010 Jan 8.

Coating of the baseplate? HAC, Porous coated, Blasted titanium, trabecular metal…





Reinforcement of the baseplate?

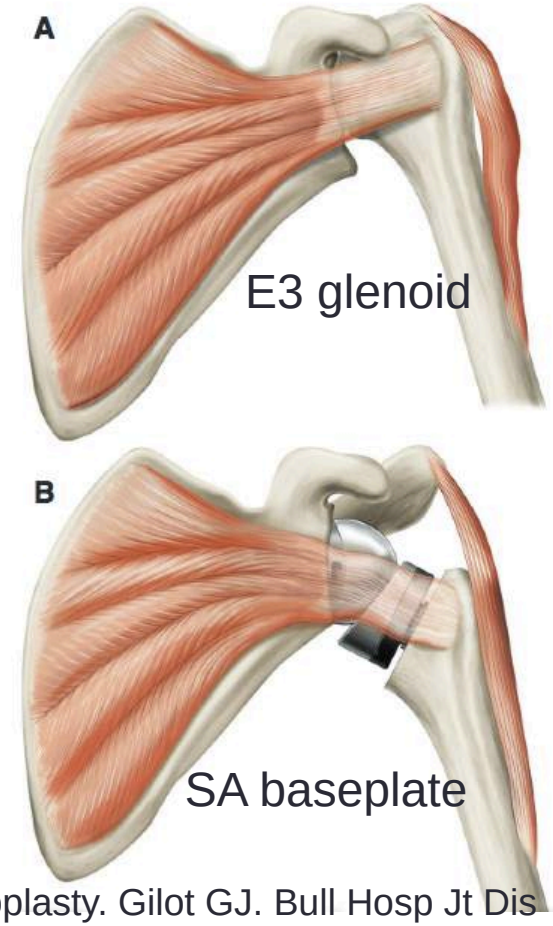


Augmentation of the baseplate?

Augmented baseplates allow the treatment of various different glenoid defects with preservation of glenoid subchondral bone.

Figure 1 A. Standard glenoid baseplate, and B. superior augmented baseplate.

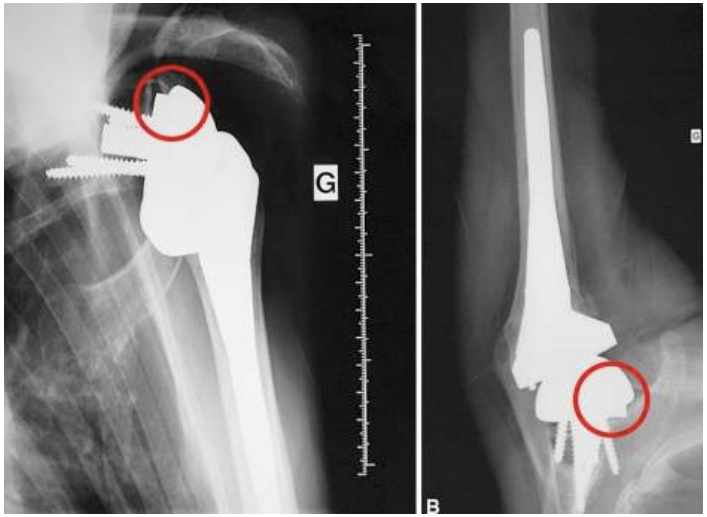
Figure 2 Posterior augmented baseplates.

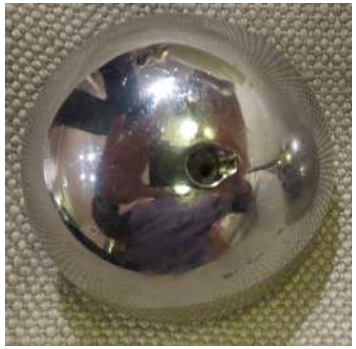


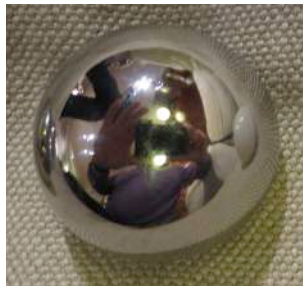
Addressing glenoid erosion in reverse total shoulder arthroplasty. Gilot GJ. Bull Hosp Jt Dis (2013). 2013;71 Suppl 2:S51-3. Review.

Connection with the glenosphere: Morse taper, small or big, circular or oval, with or without screw?

Connection needs to be good and checkable to prevent dissociation.



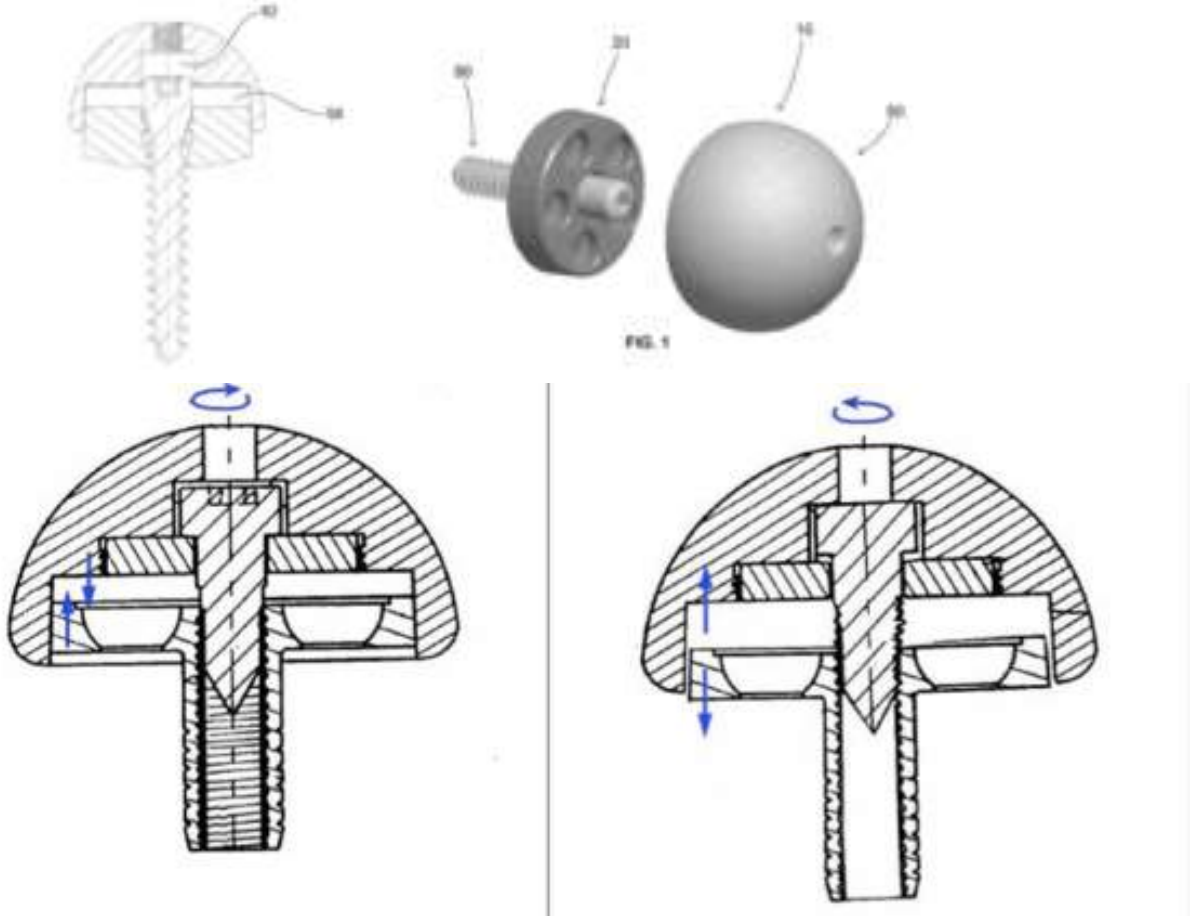




-Glenosphere disengagement is unfrequent (1.7%)
-No adverse effect for PE wear if screw hole in glenosphere is present.

-Wear simulation of reverse total shoulder arthroplasty systems: effect of glenosphere design. Vaupel ZM, Baker KC, Kurdziel MD, Wiater JM. J Shoulder Elbow Surg. 2012 Oct;21(10):1422-9. doi: 10.1016/j.jse.2011.10.024. Epub 2012 Feb 24.
-Glenosphere disengagement: a potentially serious default in reverse shoulder surgery. Middernacht B, De Wilde L, Molé D, Favard L, Debeer P. Clin Orthop Relat Res. 2008 Apr;466(4):892-8. doi: 10.1007/s11999-007-0090-6. Epub 2008 Feb 21. Erratum in: Clin Orthop Relat Res. 2008 Dec;466(12):3163.

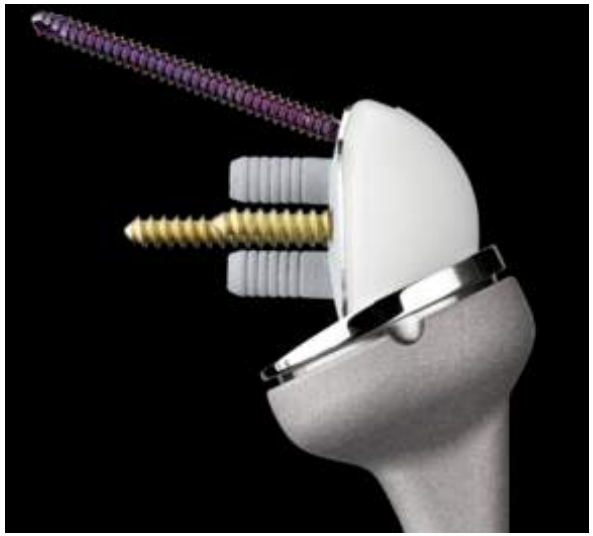
Central screw can guide and eases revision of glenosphere to baseplate.



Glenosphere.

Material: Polished Co-Cr-Ni alloy
PE

Polyethylene abrasion due to mechanical notching in the configuration with polyethylene inlay is more important than any gravimetric wear.



Wear-induced loss of mass in reversed total shoulder arthroplasty with conventional and inverted bearing materials. Kohut G, Dallmann F, Irlenbusch U. J Biomech. 2012 Feb 2;45(3):469-73. doi: 10.1016/j.jbiomech.2011.11.055. Epub 2011 Dec 27.

Glenosphere.

Morphology: Half a sphere
Less than half a sphere
More than half a sphere
With inferior extension

-The bigger the size the more difficult the assembling glenosphere to the baseplate

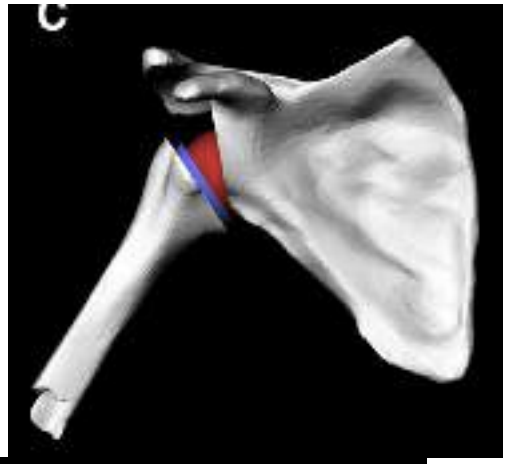
-Inferior extension resects more glenoid bone but provides less scapular notching

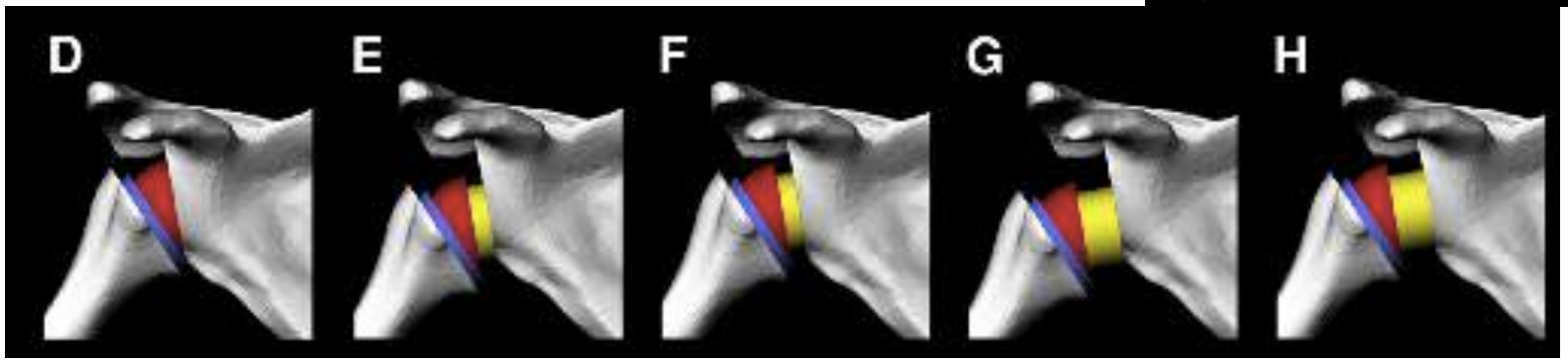
Duocentric® Duocentric® reversed shoulder prosthesis and Personal Fit® templates: innovative strategies to optimize prosthesis positioning and prevent scapular notching. Trouilloud P, Gonzalvez M, Martz P, Charles H, Handelberg F, Nyffeler RW, Baulot E; Duocentric® Group. Eur J Orthop Surg Traumatol. 2014 May;24(4):483-95.

Glenosphere.

Morphology:

-prosthesiological (non)-lateralized center of rotation



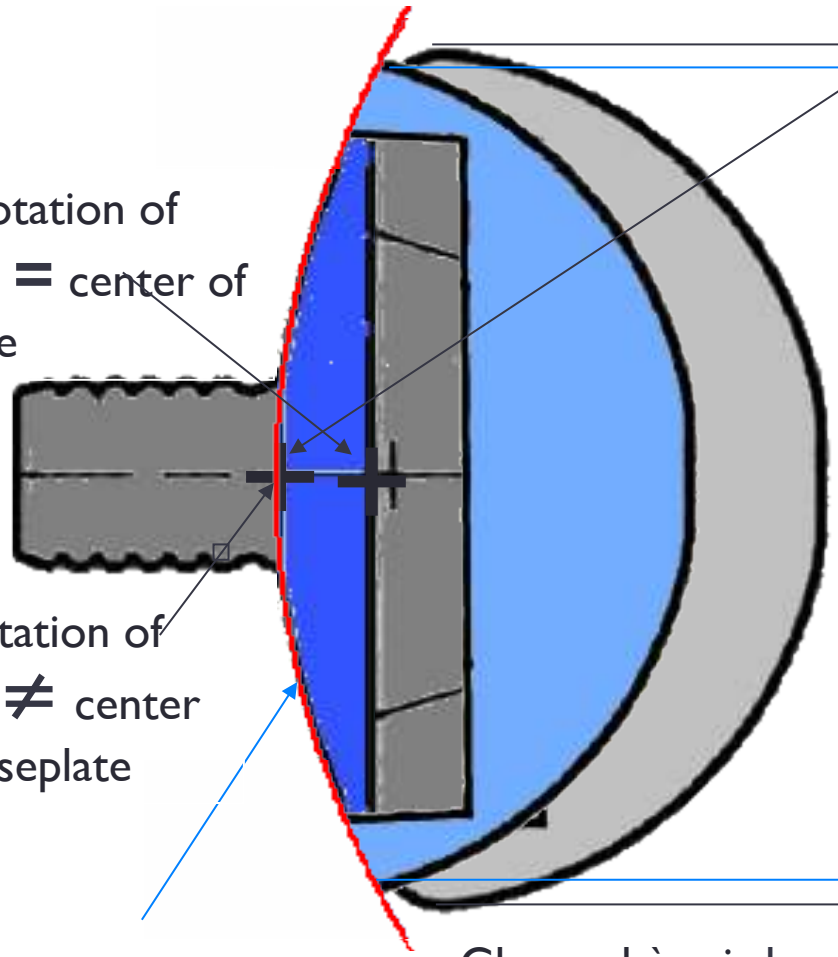


- partially medializing the glenosphere retains most of the benefits of lower deltoid and glenohumeral forces and reduces the risk for scapular notching

-Reverse total shoulder arthroplasty component center of rotation affects muscle function. Hoenecke HR Jr, Flores-Hernandez C, D'Lima DD. J Shoulder Elbow Surg. 2014 Aug;23(8):1128-35.

-Lateralized reverse shoulder arthroplasty maintains rotational function of the remaining rotator cuff. Greiner S, Schmidt C, König C, Perka C, Herrmann S.Clin Orthop Relat Res. 2013 Mar;471(3):940-6.

Glenosphere morphology determines the lateralization of the centre of rotation.



Identical center of rotation means:

Center of rotation of glenosphere = center of flat baseplate

Identical radius of glenosphere on convex baseplate → less prosthetic bulkiness of glenosphere

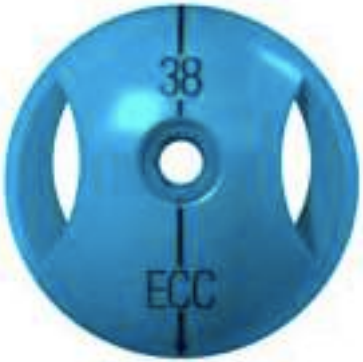
Center of rotation of glenosphere ≠ center of convex baseplate

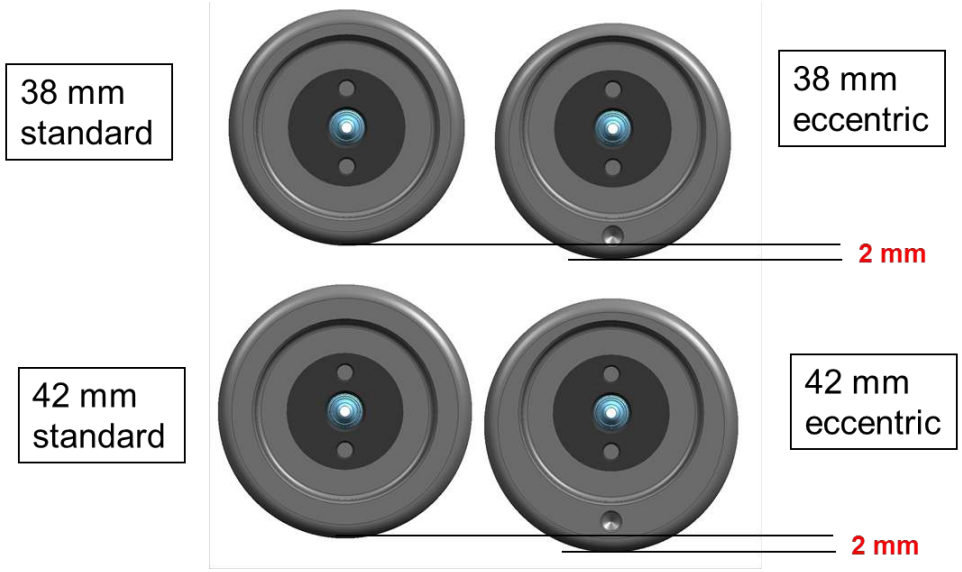
Glenosphère is less then half a sphere

Change to convex baseplate

Glenosphere

Eccentric versus Centric





Eccentric positioning reduces notching but increases stress on the baseplate…

-Biomechanical evaluation of different designs of glenospheres in the SMR reverse total shoulder prosthesis: range of motion and risk of scapular notching. Chou J, Malak SF, Anderson IA, Astley T, Poon PC.J Shoulder Elbow Surg. 2009 May-Jun;18(3):354-9. doi: 10.1016/j.jse.2009.01.015.

-Stress analysis of glenoid component in design of reverse shoulder prosthesis using finite element method. Yang CC, Lu CL, Wu CH, Wu JJ, Huang TL, Chen R, Yeh MK. J Shoulder Elbow Surg. 2013 Jul;22(7):932-9. doi: 10.1016/j.jse.2012.09.001. Epub 2013 Jan 10.

Glenosphere

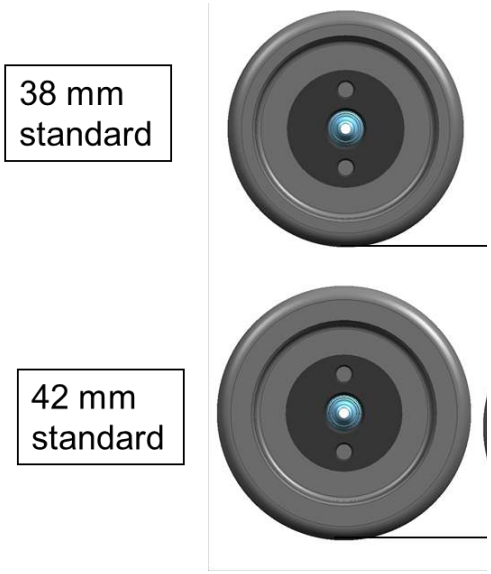
Eccentric versus Centric

- There are no differences in notching rates or clinical outcomes between concentric and eccentric glenospheres following reverse shoulder arthroplasty.
- Inferior glenosphere overhang of >3.5 mm prevents notching.
- Notching prevention may be achieved with a modified surgical technique, but eccentric glenospheres provide an additional option.

-A comparison of concentric and eccentric glenospheres in reverse shoulder arthroplasty: a randomized controlled trial. Poon PC, Chou J, Young SW, Astley T. J Bone Joint Surg Am. 2014 Aug 20;96(16):e138. doi: 10.2106/JBJS.M.00941.
-Prosthetic overhang is the most effective way to prevent scapular conflict in a reverse total shoulder prosthesis. de Wilde LF, Poncet D, Middernacht B, Ekelund A. Acta Orthop. 2010 Dec;81(6):719-26.

Glenosphere

Size : 36, 38, 40, 42, 44…



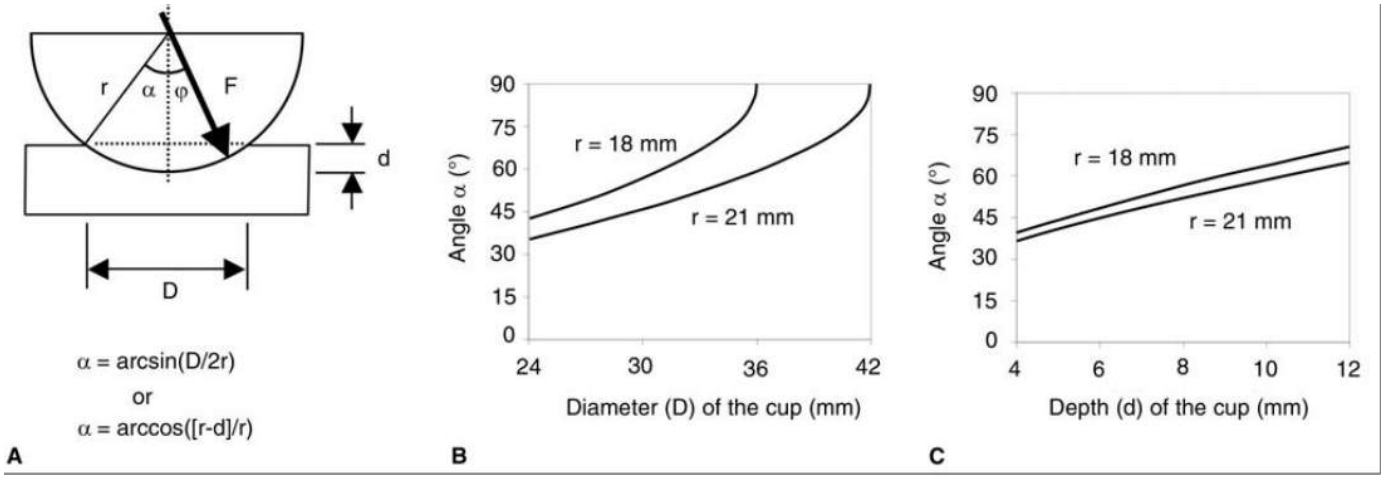
-The bigger the size the more difficult the assembling glenosphere to the baseplate

-Improvement of rotation ROM!

Influence of glenoid component design and humeral component retroversion on internal and external rotation in reverse shoulder arthroplasty: A cadaver study. Berhouet J, Garaud P, Favard L. Orthop Traumatol Surg Res. 2013 Dec;99(8):887-94. doi: 10.1016/j.otsr.2013.08.008. Epub 2013 Nov 8.

Glenosphere

Size : the smaller the diameter the more stable ?



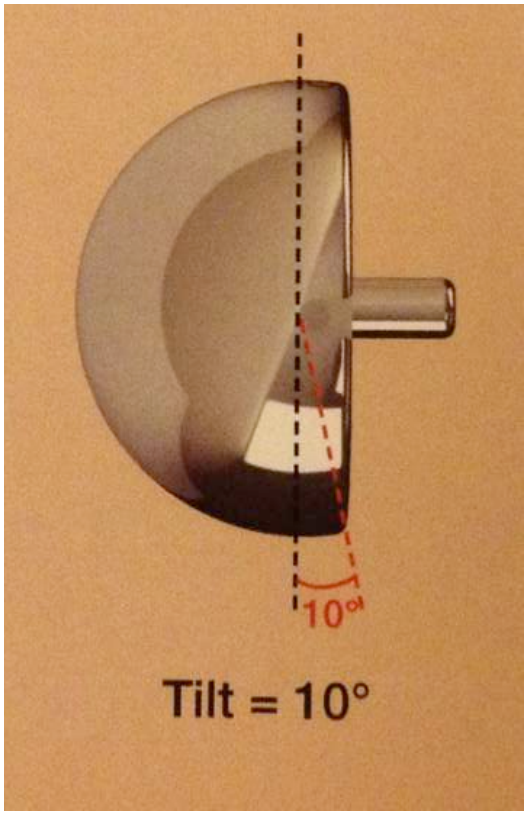
A, The joint of a reverse total shoulder arthroplasty is stable as long as the resultant force vector (F, black arrow) points inside the cup ($\varphi \leq \alpha$). The angle (α) that the joint force vector (F) can subtend without risk of dislocation depends on the diameter (D) or the depth (d) of the cup and the radius (r) of the hemisphere. **B,** For a given diameter (D) of the cup, the smaller hemisphere is more stable than the larger hemisphere. **C,** This is also true for a given depth (d) of the cup.

- Prosthetic stability is multifactorial (deltoid wrapping, deltoid lenghtening, size of the glenosphere, stiffness of soft tissue, localization of centre of rotation) and is not (only) determined by the diameter of the glenosphere!

Reverse total shoulder arthroplasty. Gerber C, Pennington SD, Nyffeler RW. J Am Acad Orthop Surg. 2009 May; 17(5):284-95. Review.

Glenosphere

Glenosphere with inbuild inferior tilt?



Varus of glenosphere medializes centre of rotation!

-Prosthetic overhang is the most effective way to prevent scapular conflict in a reverse total shoulder prosthesis. de Wilde LF, Poncet D, Middernacht B, Ekelund A. Acta Orthop. 2010 Dec;81(6):719-26. doi: 10.3109/17453674.2010.538354.

PE-liner

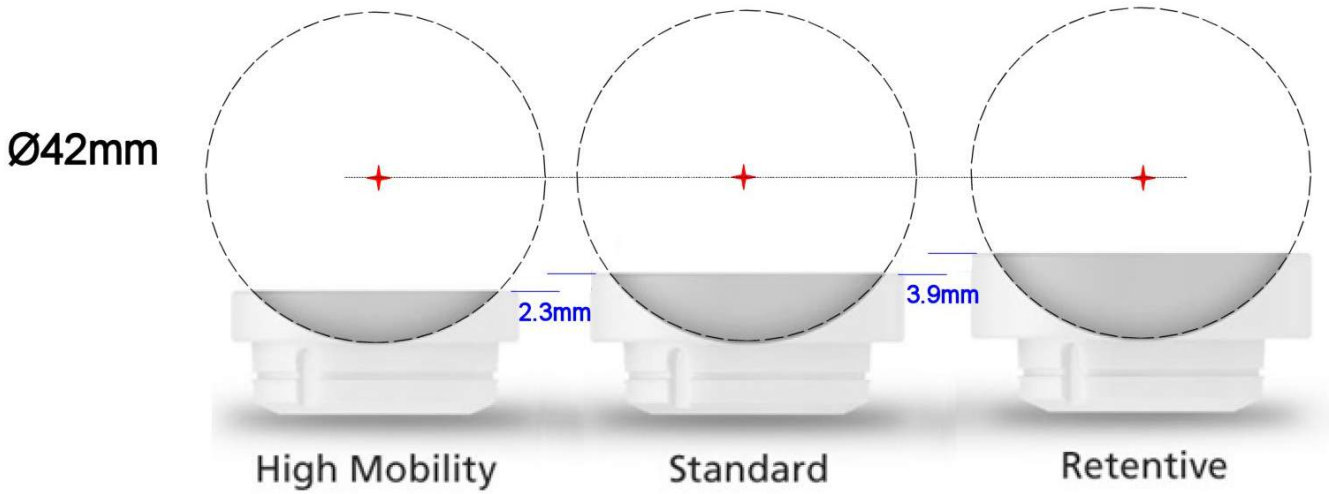
Morphology: circular
horse shoe shaped
dial-able

-Prosthetic stability is influenced by % of the contact area of the glenosphere with the PE-inlay!

-Reverse total shoulder arthroplasty. Gerber C, Pennington SD, Nyffeler RW. J Am Acad Orthop Surg. 2009 May; 17(5):284-95. Review.
-Arc of motion and socket depth in reverse shoulder implants. Gutiérrez S, Luo ZP, Levy J, Frankle MA. Clin Biomech (Bristol, Avon). 2009 Jul;24(6):473-9. doi: 10.1016/j.clinbiomech.2009.02.008. Epub 2009 Apr 5.

PE-liner

Morphology: high mobility
standard
retentive



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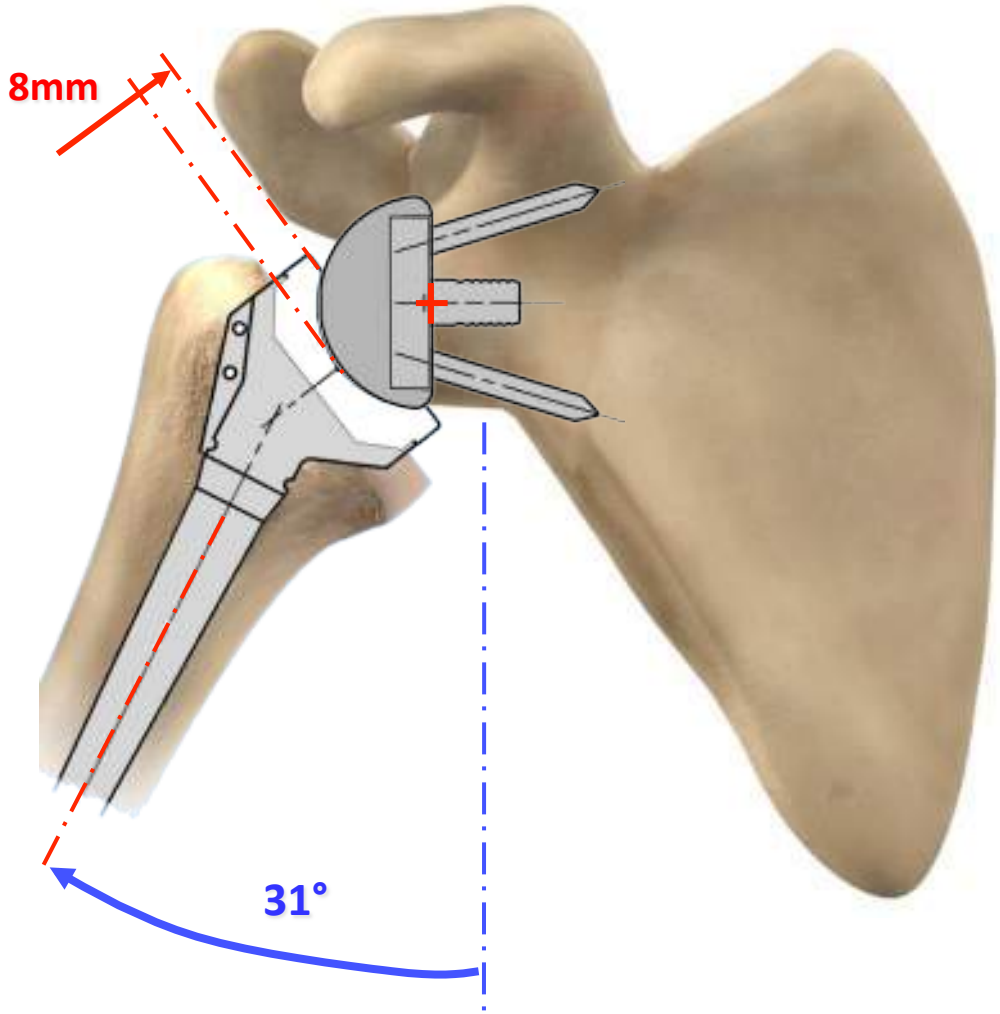
-Reverse total shoulder arthroplasty. Gerber C, Pennington SD, Nyffeler RW. J Am Acad Orthop Surg. 2009 May; 17(5):284-95. Review.
-Arc of motion and socket depth in reverse shoulder implants. Gutiérrez S, Luo ZP, Levy J, Frankle MA. Clin Biomech (Bristol, Avon). 2009 Jul;24(6):473-9. doi: 10.1016/j.clinbiomech.2009.02.008. Epub 2009 Apr 5.

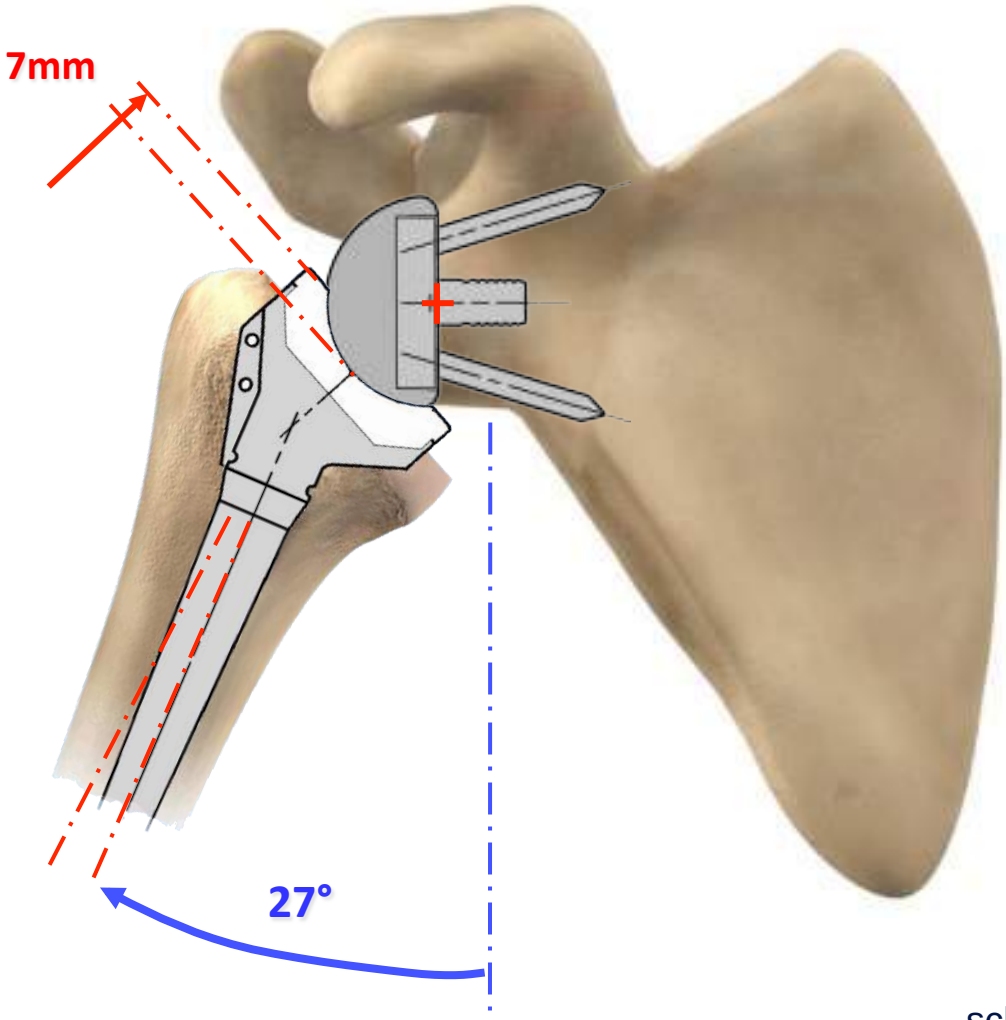
PE-liner

Morphology: high mobility, standard,retentive



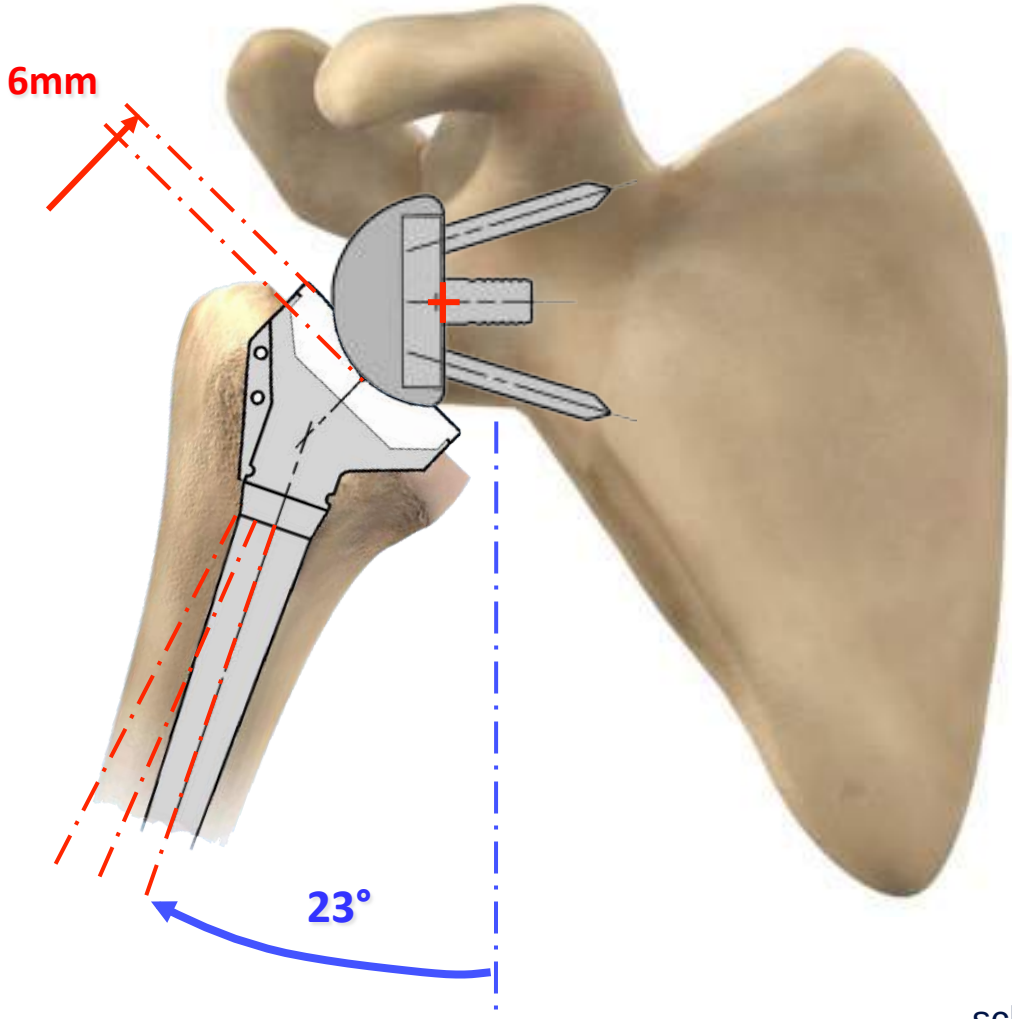
PE-liner

Morphology: high mobility, standard,retentive



PE-liner

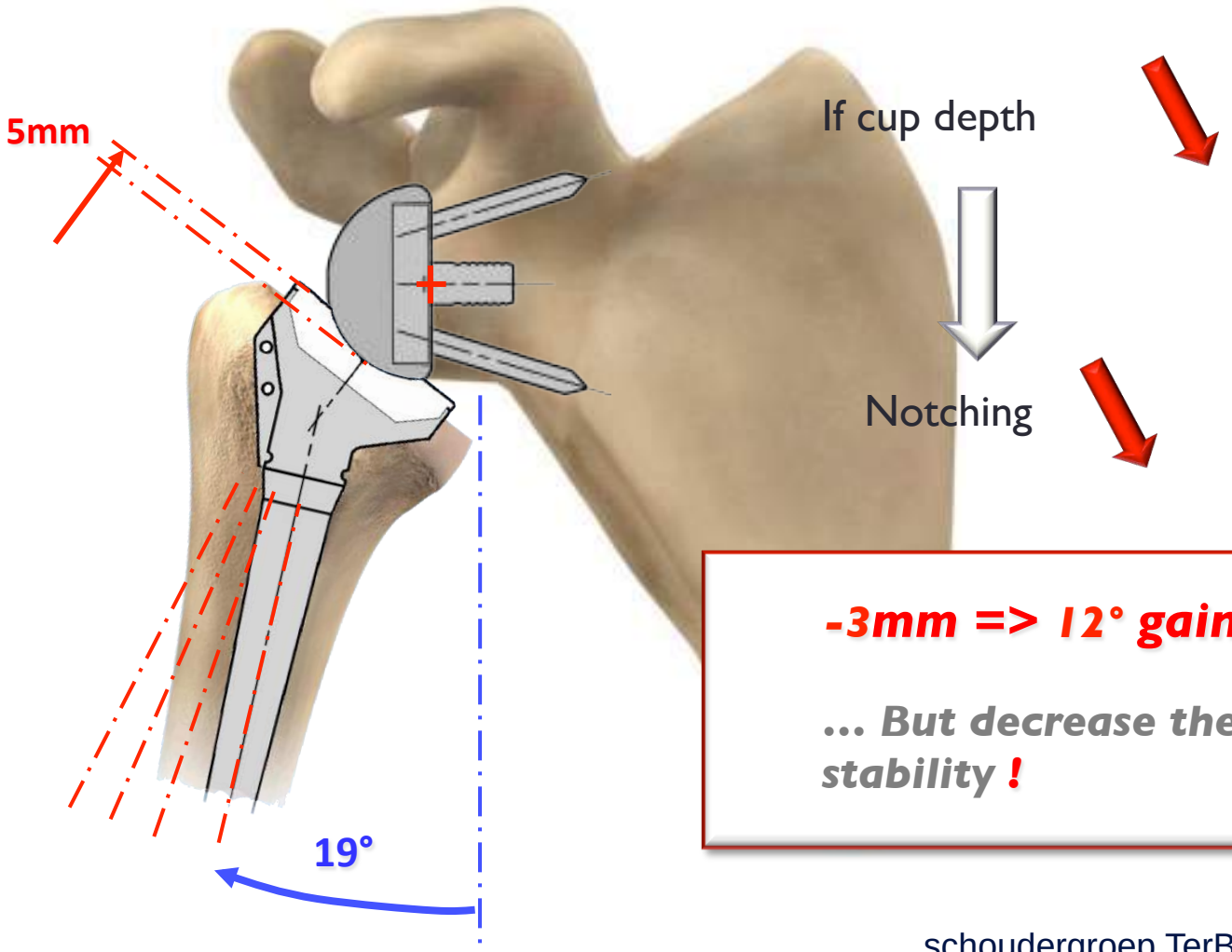
Morphology: high mobility, standard,retentive



PE-liner

-Prosthetic overhang is the most effective way to prevent scapular conflict in a reverse total shoulder prosthesis. de Wilde LF, Poncet D, Middernacht B, Ekelund A. Acta Orthop. 2010 Dec;81(6):719-26. doi: 10.3109/17453674.2010.538354.

Morphology: high mobility, standard,retentive

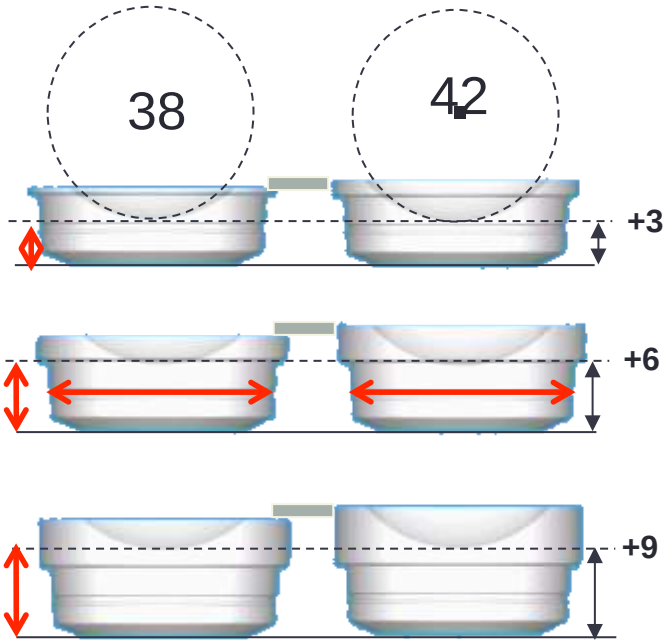


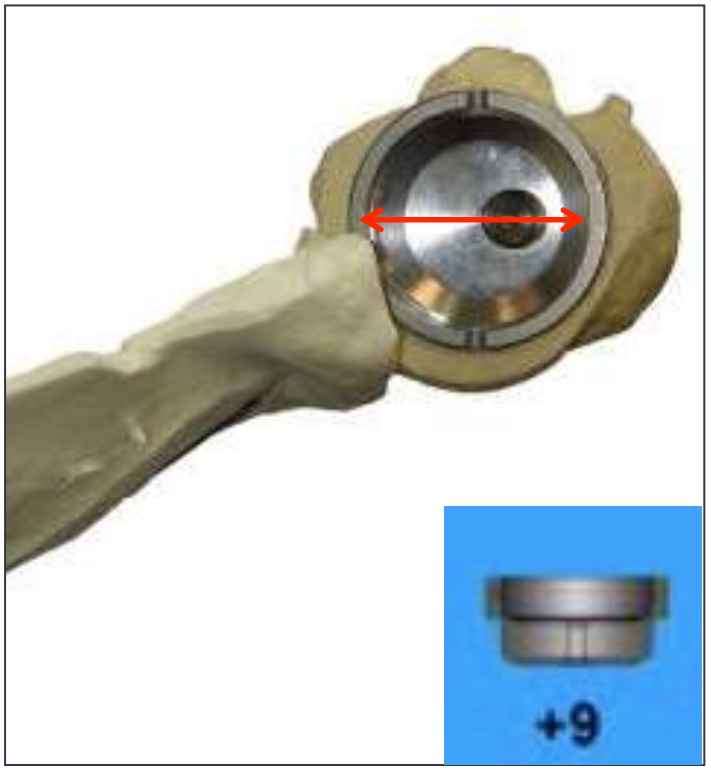
-3mm => 12° gain

… But decrease the stability !

PE-liner

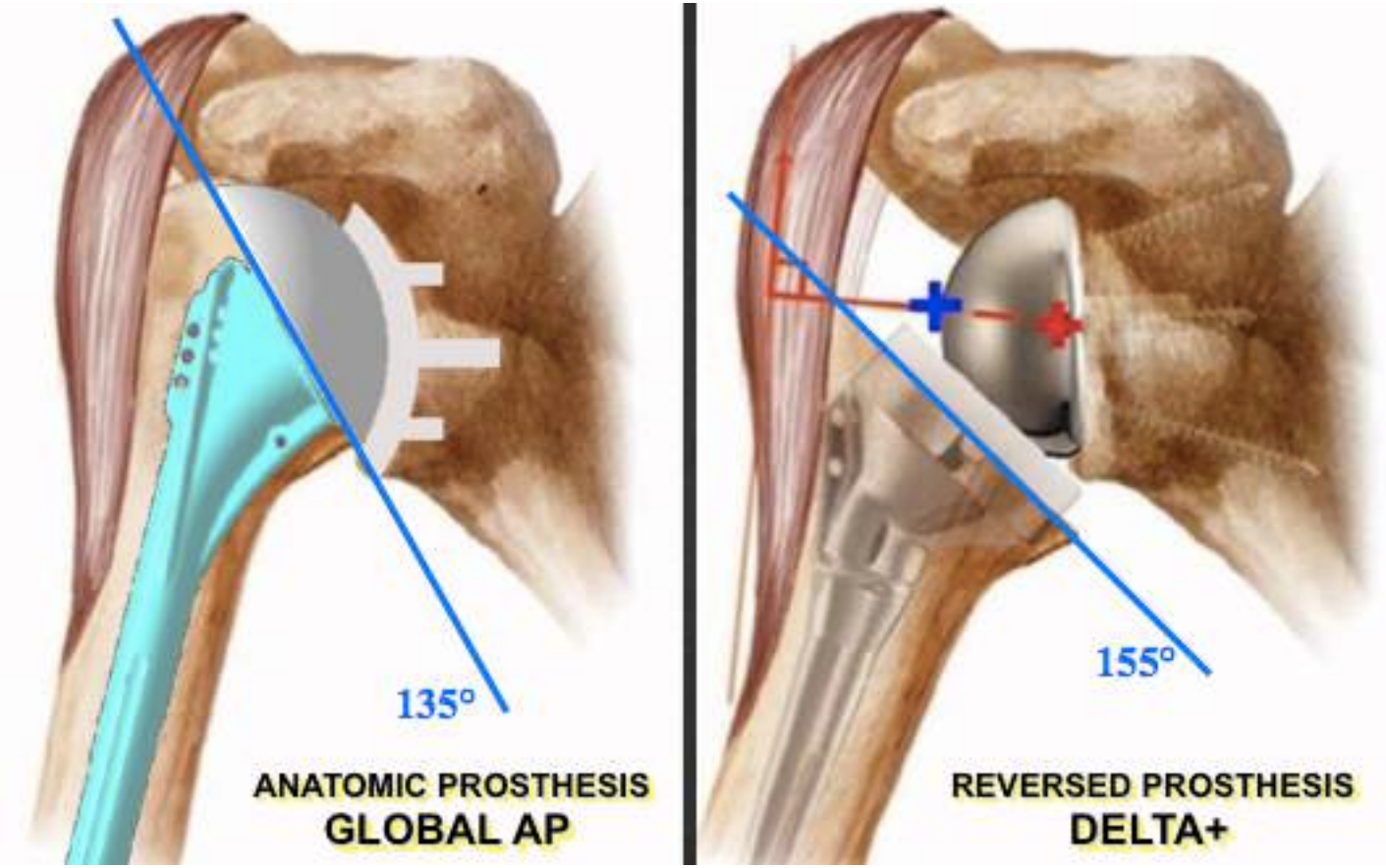
- Thickness
- Inter-adaptability to humeral sizes = all sizes at the humerus fit to the sizes at the glenosphere





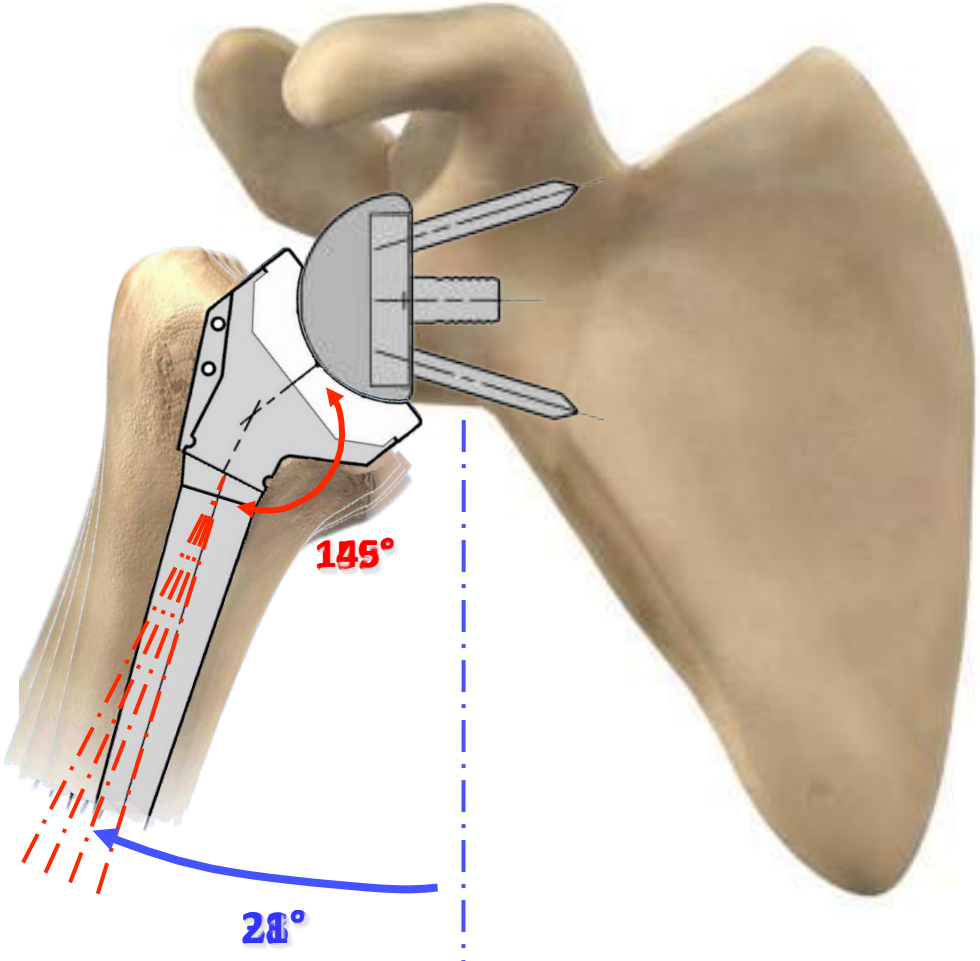
Humeral Epiphysis

Morphology: 155° (initial Grammont design) versus
135° (anatomical) varus/valgus



Humeral Epiphysis

Morphology: 155° (initial Grammont design) versus
135° (anatomical) varus/valgus



If Neck – Shaft Angle ↘

↓

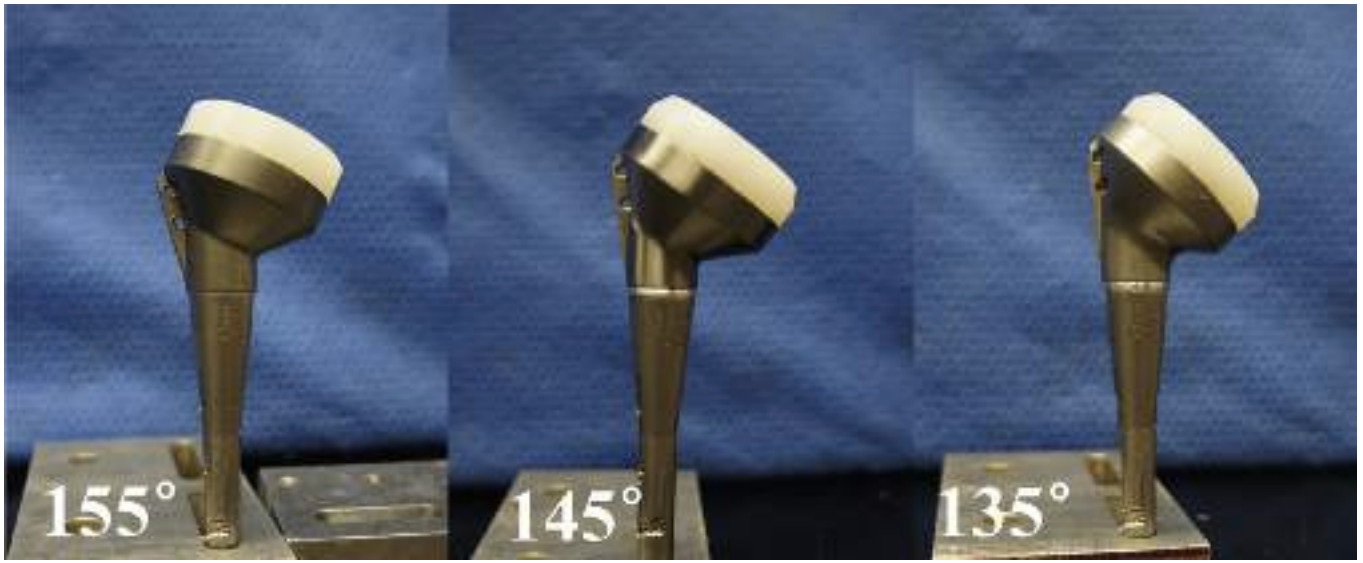
Notching ↘

155° to 145°=> 10°gain

… But decrease the Stability! (for initial abduction)

Humeral Epiphysis

Morphology: 155° (initial Grammont design) versus
135° (anatomical) varus/valgus

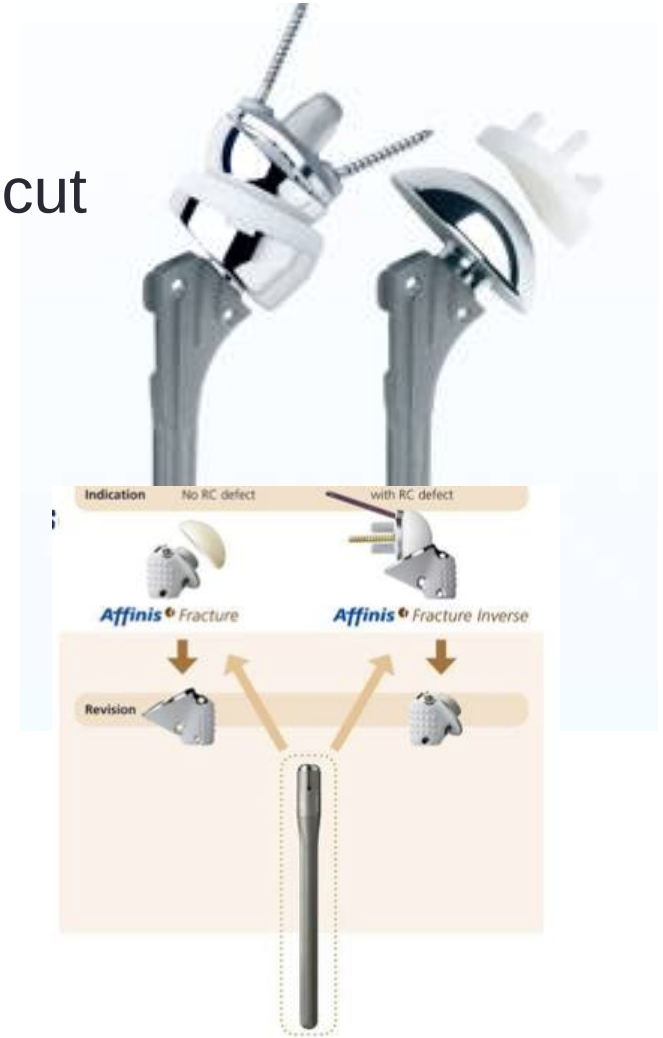


The 155° neck-shaft angle was more prone to scapular bone contact during adduction but was more stable at the internally rotated position, which was the least stable humeral rotation position. Subscapularis loading gave further anterior stability with all neck-shaft angles at all positions.

Biomechanical effects of humeral neck-shaft angle and subscapularis integrity in reverse total shoulder arthroplasty. Oh JH, Shin SJ, McGarry MH, Scott JH, Heckmann N, Lee TQ. J Shoulder Elbow Surg. 2014 Aug; 23(8):1091-8.

Humeral epiphysis

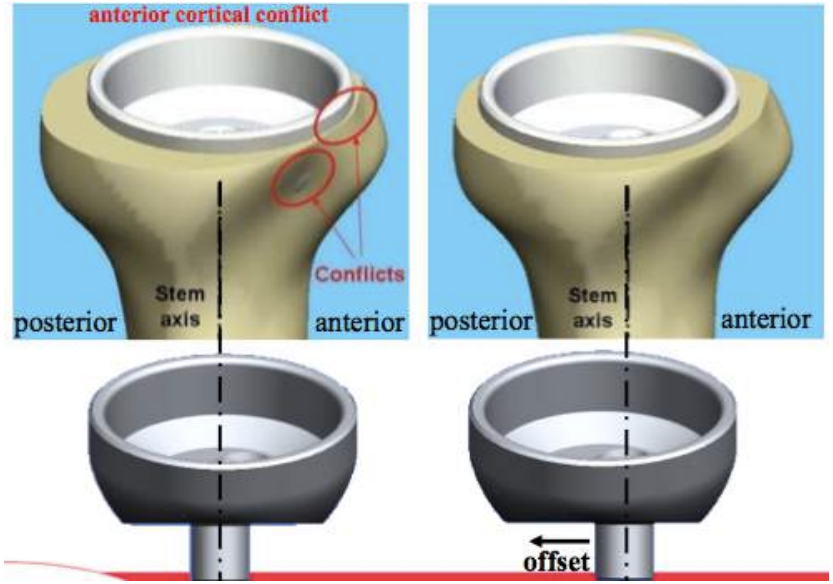
Horizontal cut versus anatomical cut



Why ? -Allows non anatomical retroversion at epiphysis and anatomical at diaphysis → cementless fixation.
-Allows common stem without humeral lengthening.
-Allows posterior offset at the humeral stem.

Humeral Epiphysis

Morphology: with posterior offset
without posterior offset (monoblock)



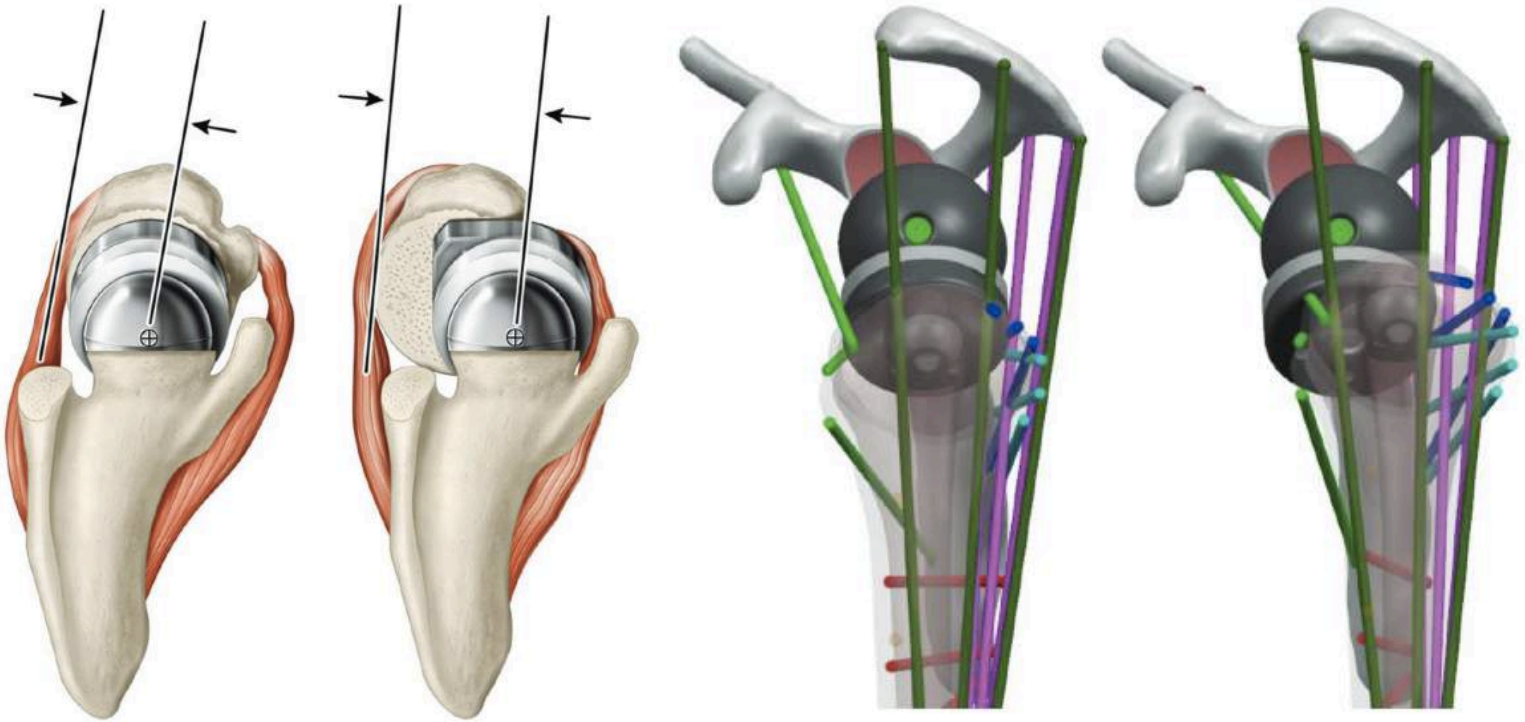
-Posterior offset allows for more anatomical press fitt without (anterior) bony destruction

-The offset humeral tray increased the external rotation moment arms.

Design rationale for a posterior/superior offset reverse shoulder prosthesis. Roche CP, Hamilton MA, Diep P, Flurin PH, Routman HD. Bull Hosp Jt Dis (2013). 2013;71 Suppl 2:18-24.

Humeral Epiphysis

Morphology: with posterior offset

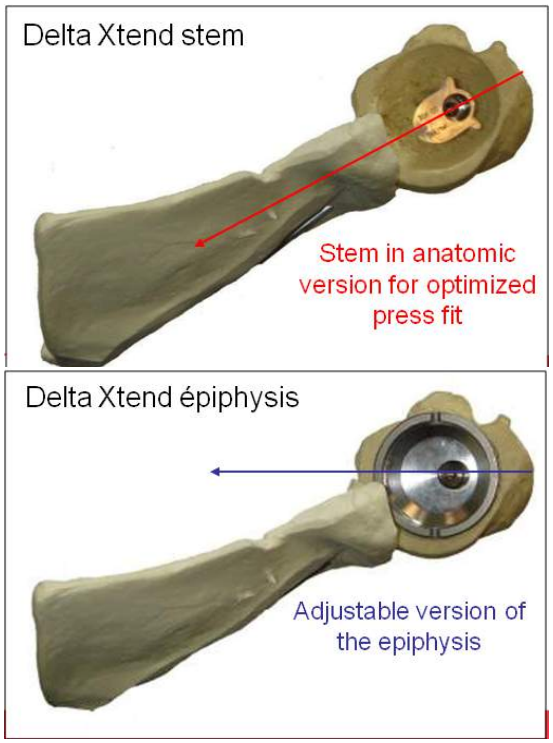


-Posterior offset allows for better tensioning and increased rotation moment arms but are more prone to impinge in extreme rotation

Design rationale for a posterior/superior offset reverse shoulder prosthesis. Roche CP, Hamilton MA, Diep P, Flurin PH, Routman HD. Bull Hosp Jt Dis (2013). 2013;71 Suppl 2:18-24.

Humeral Epiphysis

Morphology: horizontal cut

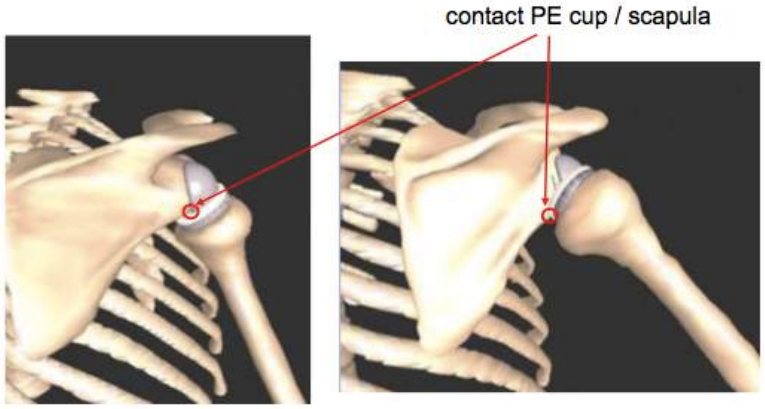


- Different epiphyseal retroversion is possible with anatomical humeral stem retroversion theoretically allowing a press fitt cementless fixation
- Revision is possible with leaving a well fixed humeral stem

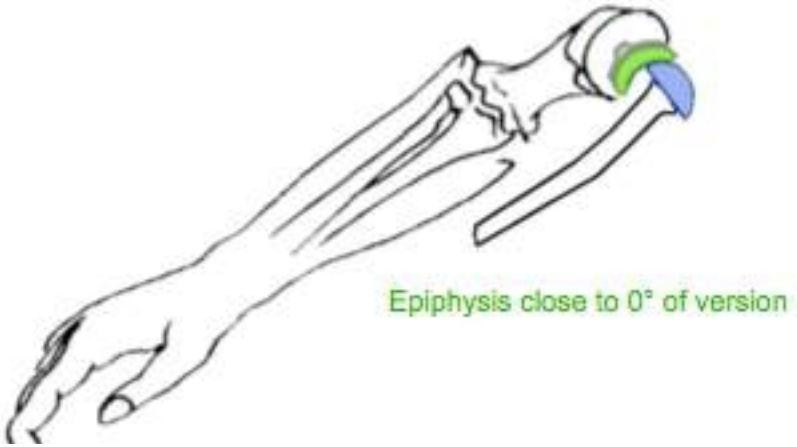
-Design rationale for a posterior/superior offset reverse shoulder prosthesis. Roche CP, Hamilton MA, Diep P, Flurin PH, Routman HD. Bull Hosp Jt Dis (2013). 2013;71 Suppl 2:18-24.
-Revision to reverse shoulder arthroplasty with retention of the humeral component.Werner BS, Boehm D, Gohlke F. Acta Orthop. 2013 Oct;84(5):473-8.

Humeral stem

Why is a different retroversion necessary for humeral stem and epiphysis ?



The reversed design limit the internal rotation (in anatomic version !)



- Although this is only true for < 30° of abduction → anatomical retroversion is acceptable.
- Body mass matters !

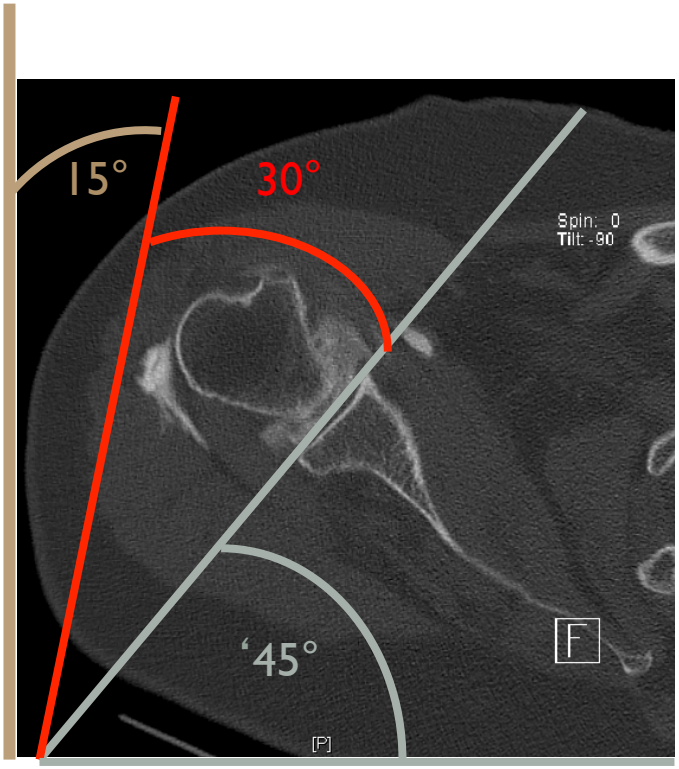
Effect of humeral component version on impingement in reverse total shoulder arthroplasty. Stephenson DR, Oh JH, McGarry MH, Rick Hatch GF 3rd, Lee TQ. J Shoulder Elbow Surg. 2011 Jun;20(4):652-8. doi: 10.1016/j.jse.2010.08.020. Epub 2010 Dec 8.

Humeral stem

Alternative method, patient specific retroversion.

CT scan:

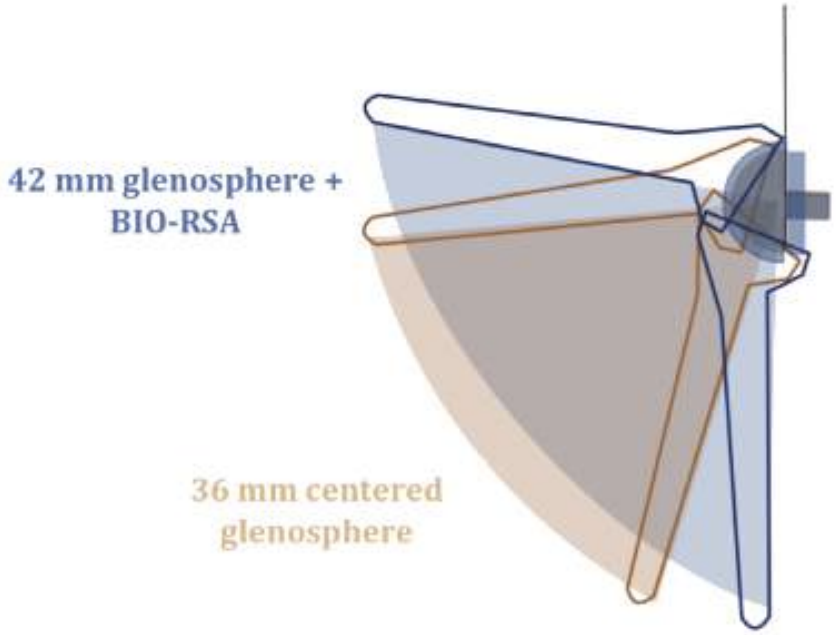
- 1. glenoid angulation = 45°
- 2. anterior opening wedge 30°
- 3. humeral angulation (with the forearm in the sagittal plane) = 15° retroversion



Prosthetic component relationship of the reverse Delta III total shoulder prosthesis in the transverse plane of the body. Karelse AT, Bhatia DN, De Wilde LF. J Shoulder Elbow Surg. 2008 Jul-Aug;17(4):602-7. doi: 10.1016/j.jse.2008.02.005. Epub 2008 May 2.

Relation glenosphere<>humeral stem

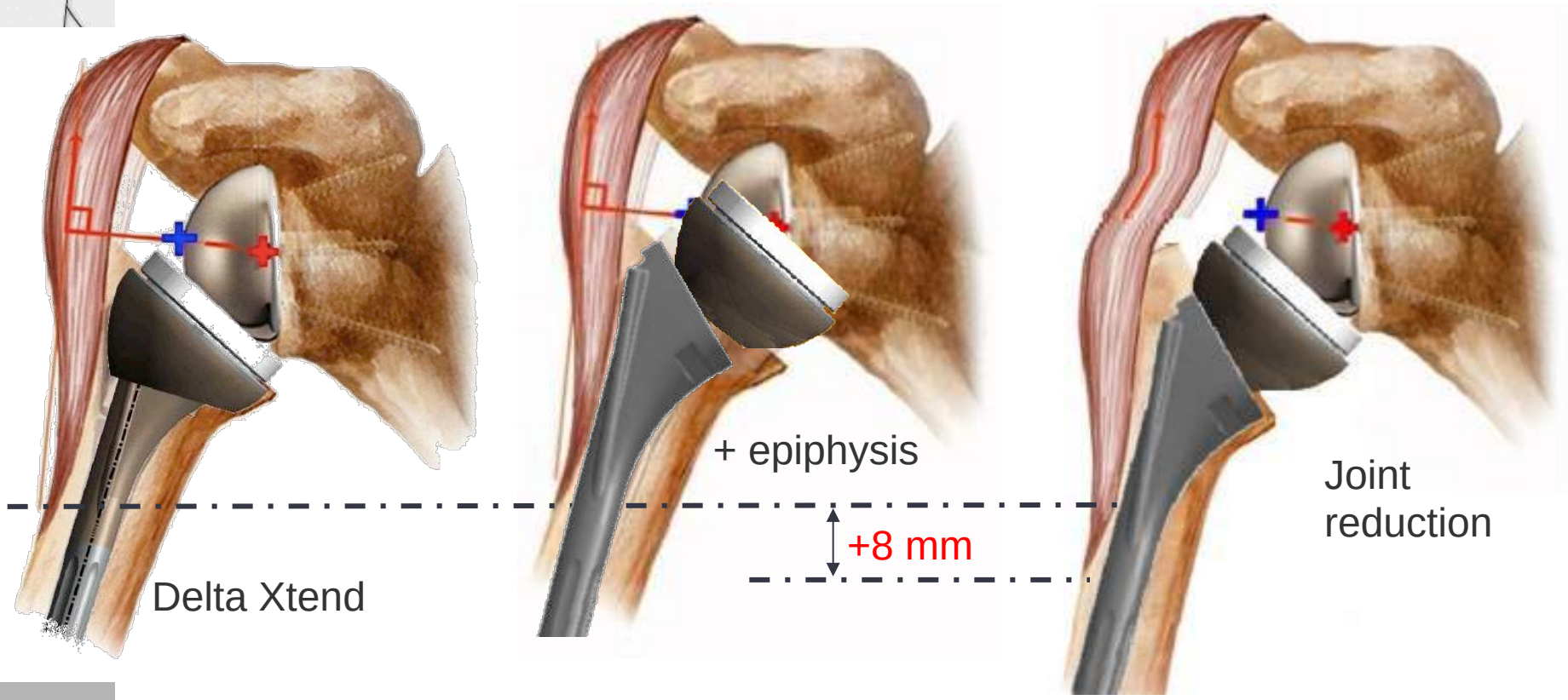
Inferior scapular notching can be most effectively prevented by using large-diameter glenospheres with lateralized COR and by making sure to replicate the patient's native humeral retroversion.



Evaluation of the role of glenosphere design and humeral component retroversion in avoiding scapular notching during reverse shoulder arthroplasty. Berhouet J, Garaud P, Favard L. J Shoulder Elbow Surg. 2014 Feb;23(2):151-8.

Humeral epiphysis

Horizontal cut → platform stem (anatomical→ reverse)



- Allows for common stem (from anatomical to reverse) *without* humeral lengthening

Revision to reverse shoulder arthroplasty with retention of the humeral component.Werner BS, Boehm D, Gohlke F. Acta Orthop. 2013 Oct;84(5):473-8.

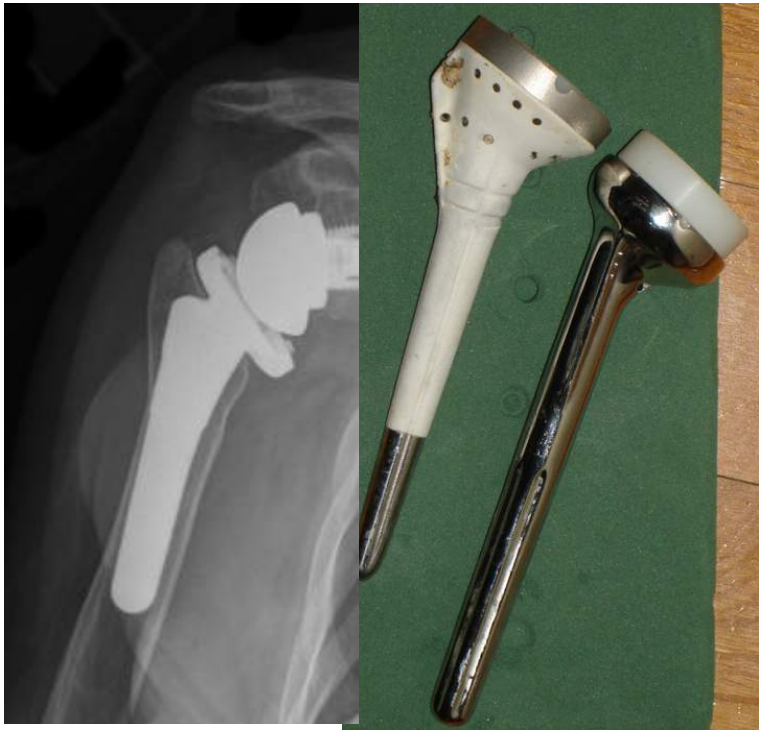
Humeral epiphysis

Is a humeral stem necessary in Rtsa ? = results, more bonestock in case of revision!

-Results of a stemless reverse shoulder prosthesis at more than 58 months mean without loosening. Ballas R, Béguin L. J Shoulder Elbow Surg. 2013 Sep;22(9):e1-6. doi: 10.1016/j.jse.2012.12.005. Epub 2013 Feb 15.
-The TESS reverse shoulder arthroplasty without a stem in the treatment of cuff-deficient shoulder conditions: clinical and radiographic results. Teissier P, Teissier J, Kouyoumdjian P, Asencio G. J Shoulder Elbow Surg. 2014 Jul 11. pii: S1058-2746(14)00226-2. doi: 10.1016/j.jse.2014.04.005. [Epub ahead of print]

Humeral diaphysis

Stemless, short stem, cementless stem, cemented stem, monoblock: different indications.



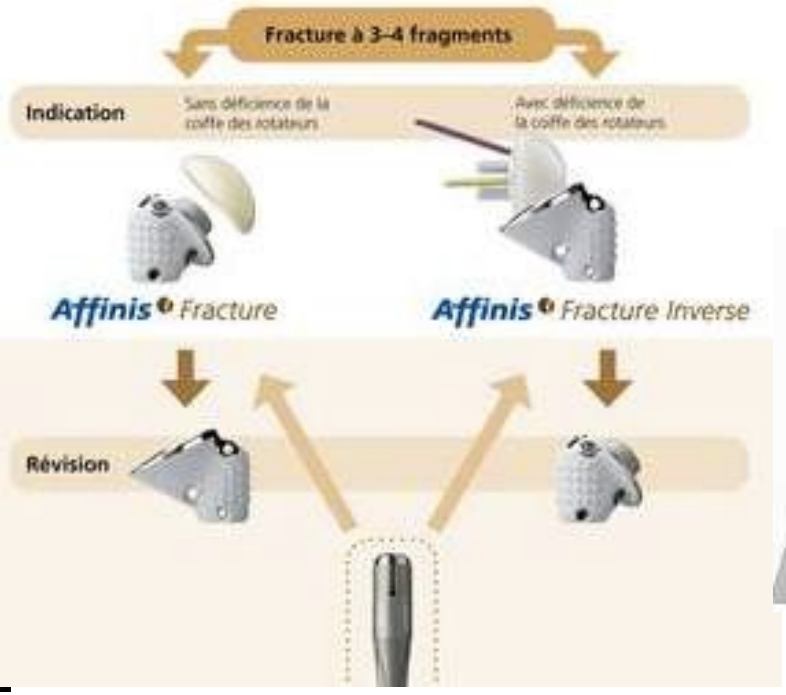
-Reverse shoulder arthroplasty with a short metaphyseal humeral stem. Atoun E, Van Tongel A, Hous N, Narvani A, Relwani J, Abraham R, Levy O. Int Orthop. 2014 Jun;38(6):1213-8.

-Short-stem uncemented primary reverse shoulder arthroplasty: clinical and radiological outcomes. Giuseffi SA, Streubel P, Sperling J, Sanchez-Sotelo J. Bone Joint J. 2014 Apr;96-B(4):526-9.

Humeral epiphysis

Is a humeral fracture stem necessary in Rtsa ?

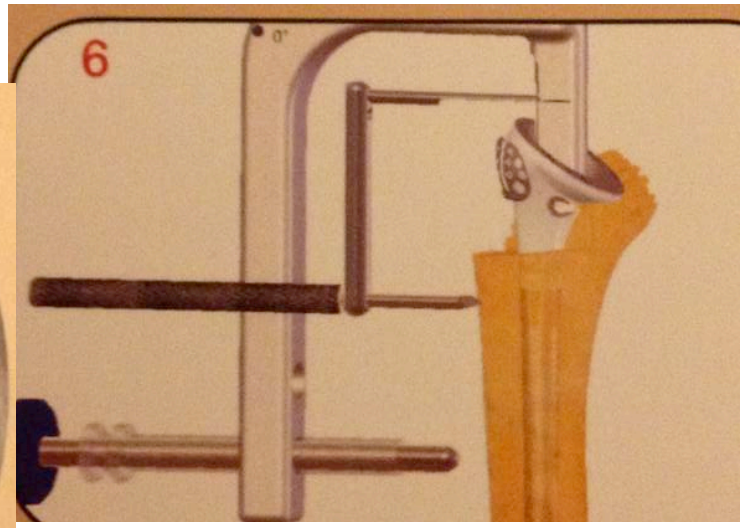
- Mean normalized CS: 88 normal → 97 specific
- Scapular notching: 25% normal →No notching specific



-Newly developed modular reverse fracture endoprosthesis in non-reconstructable humeral head fracture in old people. Reuther F, Kohut G, Nijs S. Oper Orthop Traumatol. 2014 Aug;26(4):369-82;
-Reverse shoulder arthroplasty for the treatment of three-part and four-part proximal humeral fractures in the elderly. Ross M, Hope B, Stokes A, Peters SE, McLeod I, Duke PF. J Shoulder Elbow Surg. 2014 Aug 26. pii: S1058-2746(14)00319-X. doi: 10.1016/j.jse.2014.05.022. [Epub ahead of print]

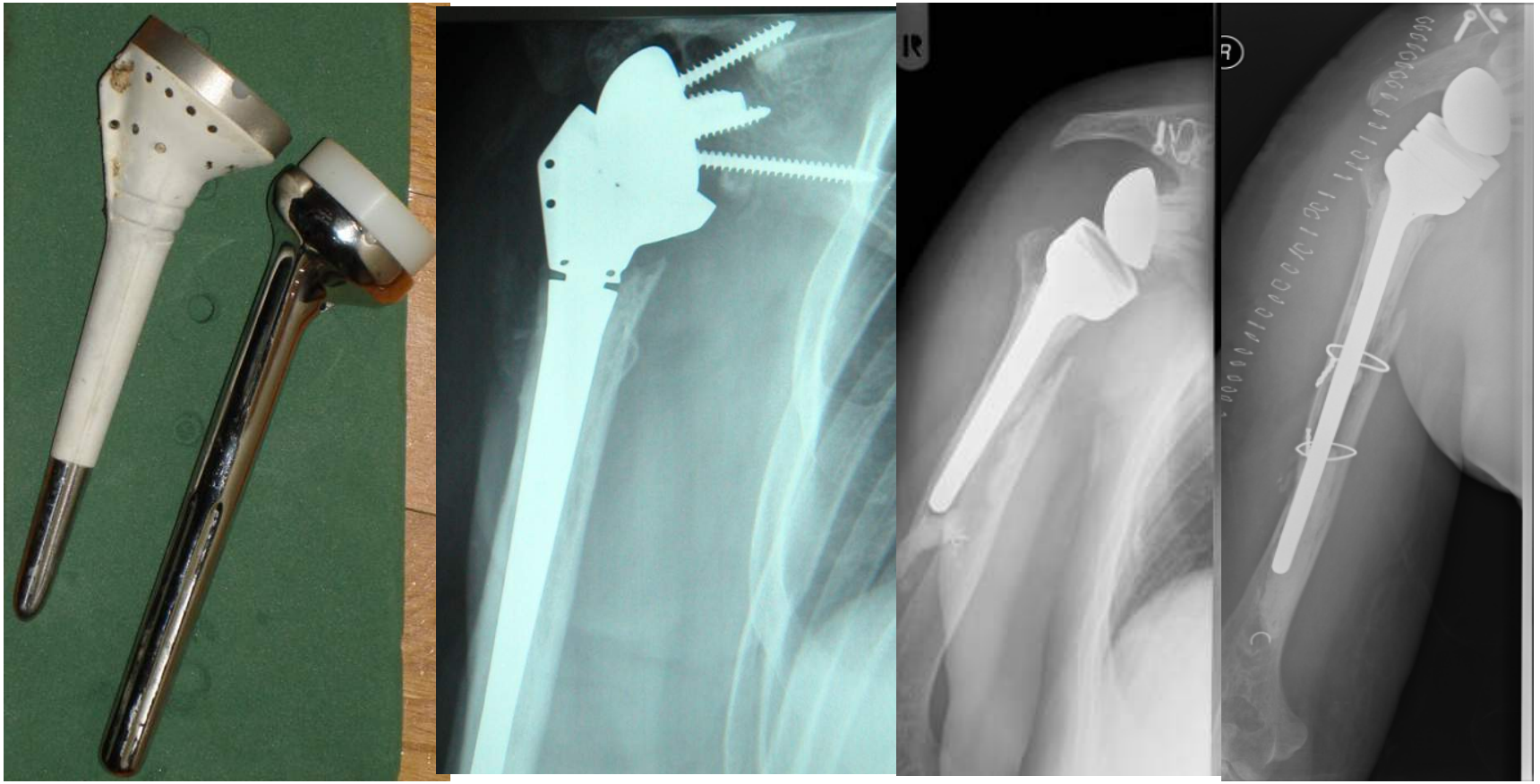
Humeral diaphysis

Stem with locking screws to treat fractures totally without cement ?



Humeral diaphysis

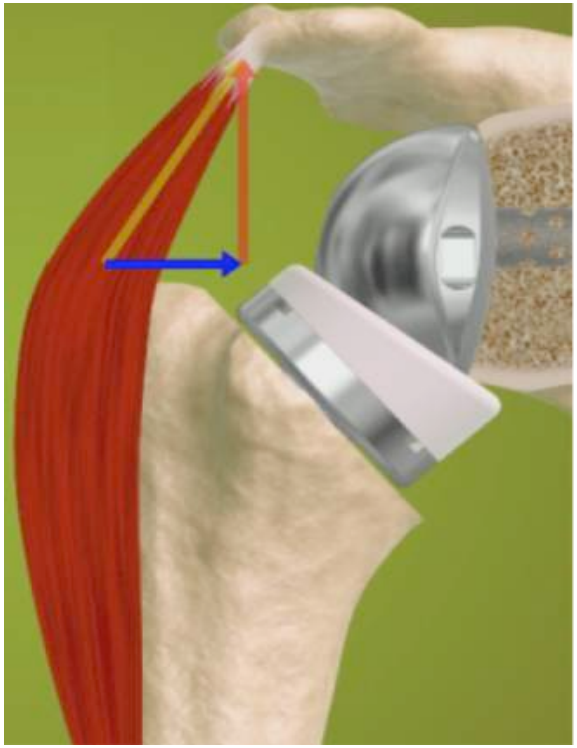
Longstem for revision, tumours or fractures.

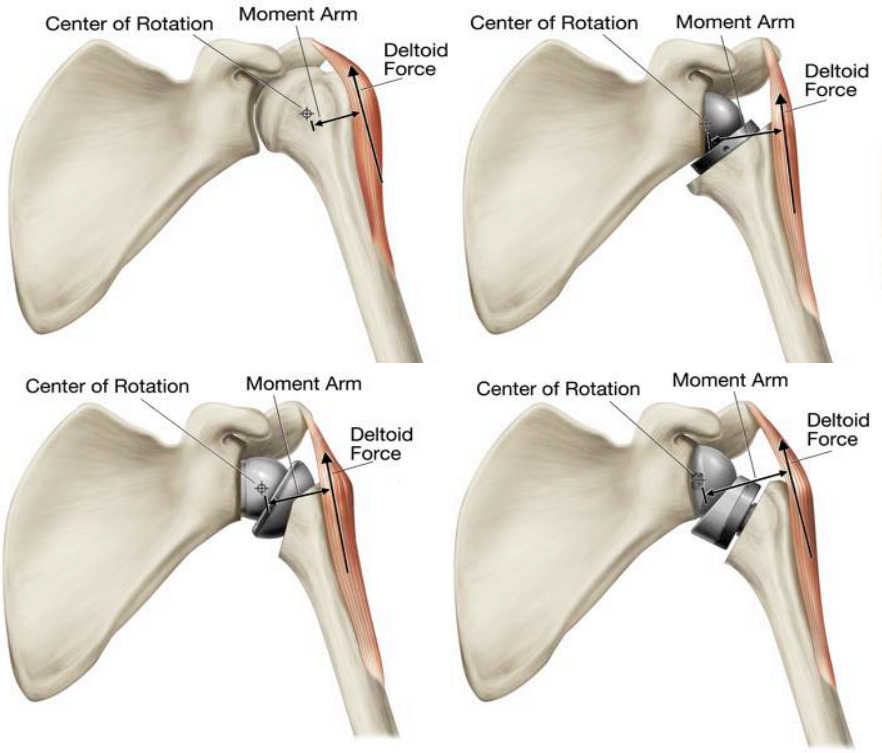


Gleno-Humeral relationship

Important for deltoid wrapping angle:

- stability
- deltoid force arm





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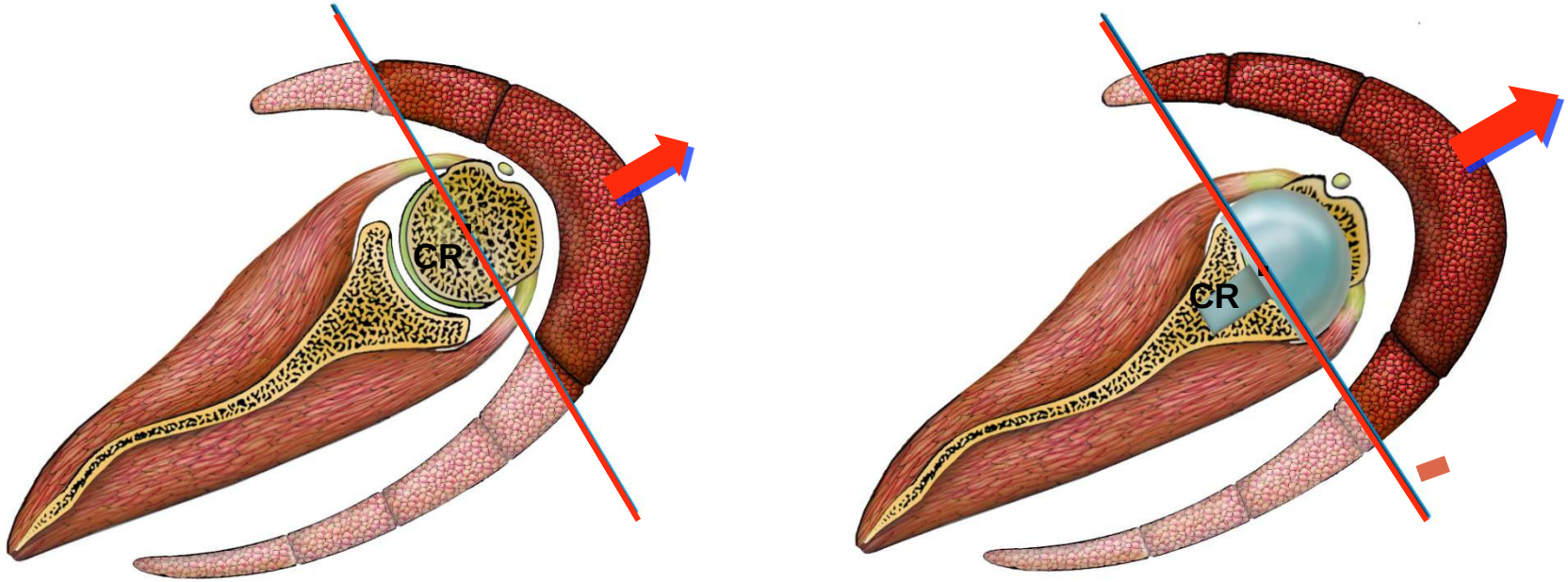
Gleno-Humeral relationship

Important for deltoid power

→ medialisation of centre of rotation (CR)

→ lateralizing CR ➔ less deltoid power



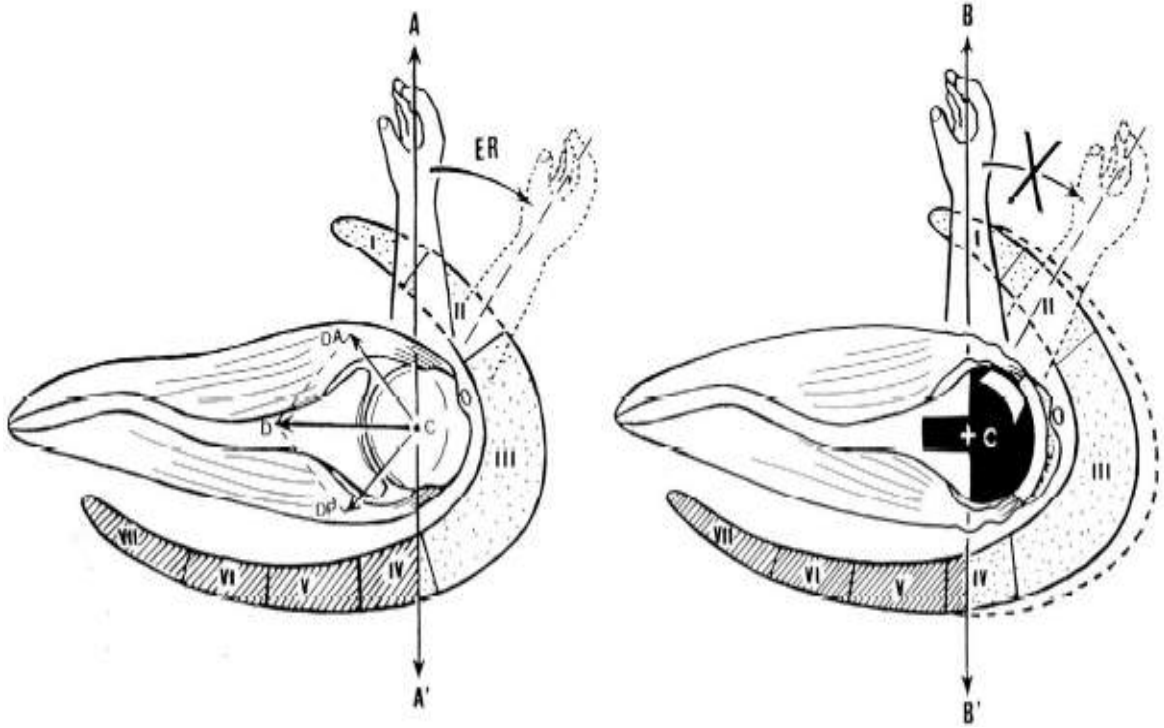
Grammont reverse prosthesis: design, rationale, and biomechanics. Boileau P, Watkinson DJ, Hatzidakis AM, Balg F. J Shoulder Elbow Surg. 2005 Jan-Feb;14(1 Suppl S):147S-161S. Review.

Gleno-Humeral relationship

Important for rotator cuff remnants

→ medialisation CR ➔ less RC power

→ lateralizing CR ➔ more RC power



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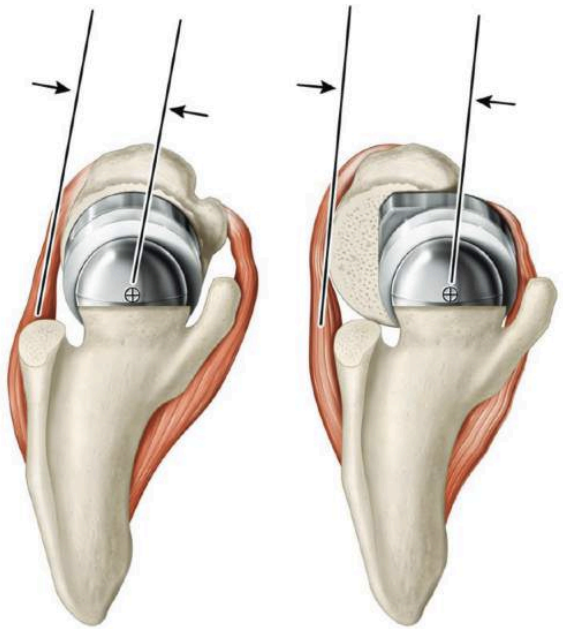
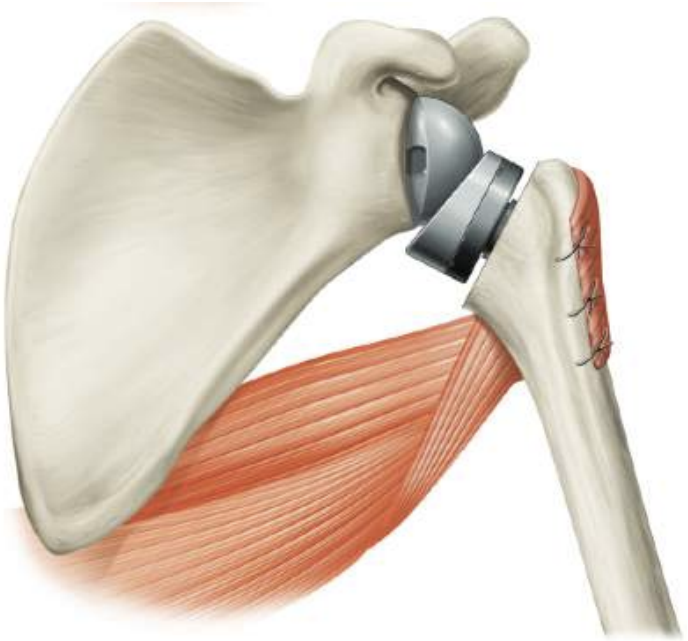
Gleno-Humeral relationship

Important for remnants of the rotator cuff:

- lateralized RSA maintains the length and rotational moment arms of the ssc and tm, the flexion forces increase but abduction capability decrease.





-Combined latissimus dorsi and teres major tendon transfers for external rotation deficiency in reverse shoulder arthroplasty. Grey SG. Bull Hosp Jt Dis (2013). 2013;71 Suppl 2:82-7.

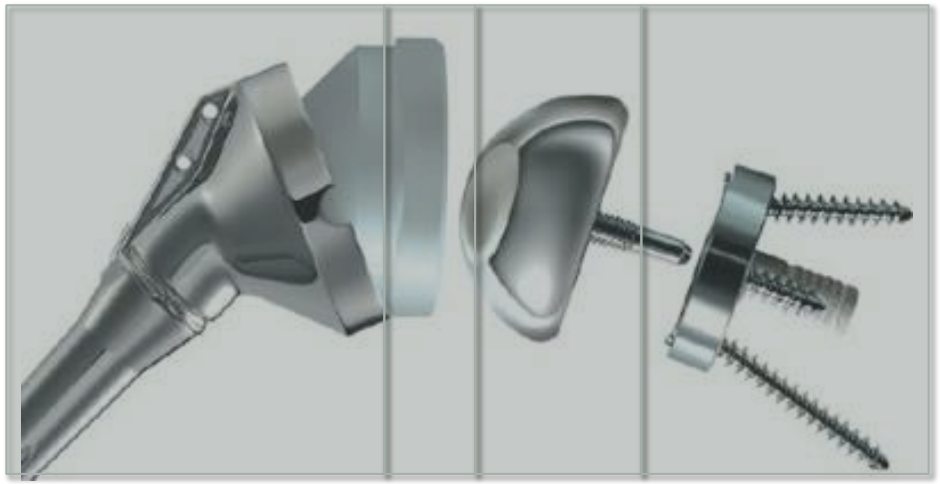
-Effect of prosthesis design on muscle length and moment arms in reverse total shoulder arthroplasty. Hamilton MA, Roche CP, Diep P, Flurin PH, Routman HD. Bull Hosp Jt Dis (2013). 2013;71 Suppl 2:S31-5.

-Lateralized reverse shoulder arthroplasty maintains rotational function of the remaining rotator cuff. Greiner S, Schmidt C, König C, Perka C, Herrmann S.Clin Orthop Relat Res. 2013 Mar;471(3):940-6.

Gleno-Humeral relationship

Determined by:

- lateralizing gh centre of rotation (cr)
- Size of glenosphere
- PE thickness
- humeral lateralization
- humeral inclination



Revision surgery of reverse shoulder arthroplasty. Boileau P, Melis B, Duperron D, Moineau G, Rumian AP, Han Y. J Shoulder Elbow Surg. 2013 Oct;22(10):1359-70.

Conclusion

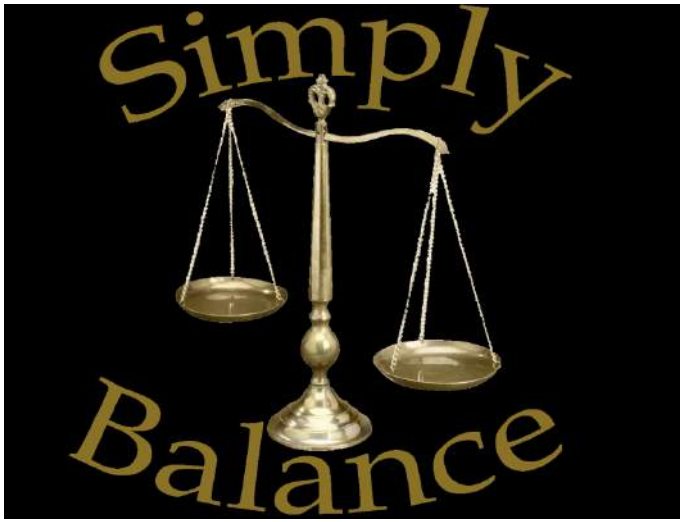
- Create room around the glenosphere → better ROM
- Convex back removes less bone than flat in uniconcave glenoids
- Flat back removes less bone in biconcave glenoids
- Fixed central keel > screw > plot enhances initial fixation
- Long pegs are necessary to use if bone grafting is indicated
- Small reamers remove less bone → better glenoid strength
- Angulated stable screws (minimal 2) enhance initial fixation
- Coating enhances bony ingrowth
- Morse taper :
  - Screw can assure good assembling
  - More contact area improves stability

Conclusion

- Glenosphere screw controls impaction to the baseplate
- PE wear for PE glenosphere </= Co-Cr-Ni glenosphere
- Less than half a sphere glenosphere eases surgery
- Biggest glenosphere to prevent slackening of the RC remants
- High Mobility PE liner if sufficient prosthetic stability
- Initial 155° varus angulated stem <> 135° anatomical ???
- Horizontal cut off stem allows for more flexibility in revision surgery.
- Different retroversion diaphysis/epiphysis → enhancement of rotational motion?
- Long stem is appropriate in revision surgery

Conclusion

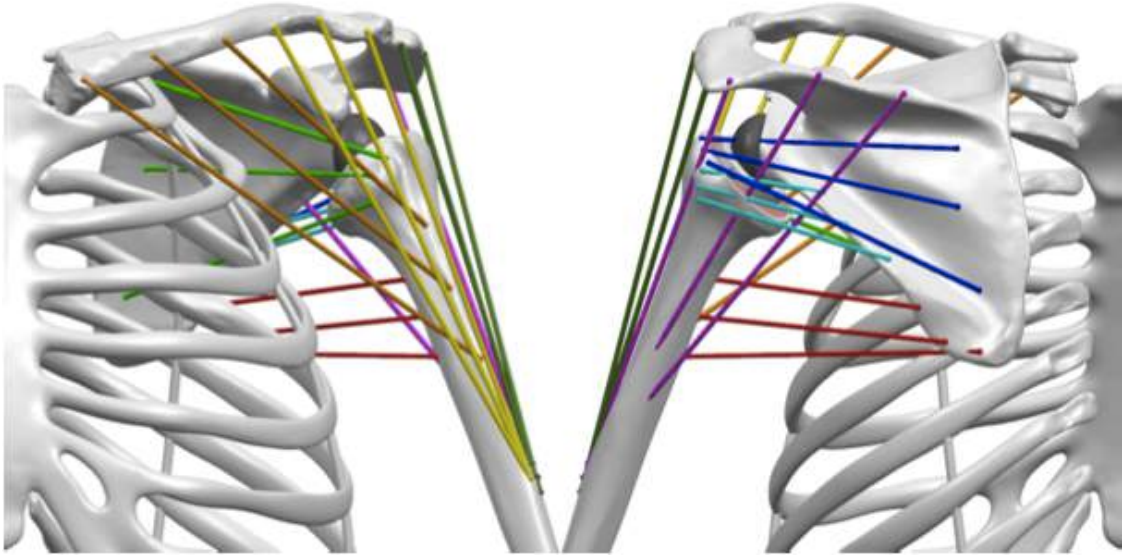
- Conversion from anatomical to reverse is OK (cave lenthening and lateralizing in anatomical stem)
- Cemented *Monoblock* is necessary for revision and tumor
- The glenoid is more important than humerus
- Many different options and increasing basic science and experience → benefit for shoulder function ?



Conclusion

Minor differences in prosthesis design parameters (< 10 mm of glenoid and humeral offset and <10° of humeral neck angle) relative to the Grammont reverse shoulder can improve shoulder function

→ *patient specific reverse prosthesis ?*



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THANK YOU !