

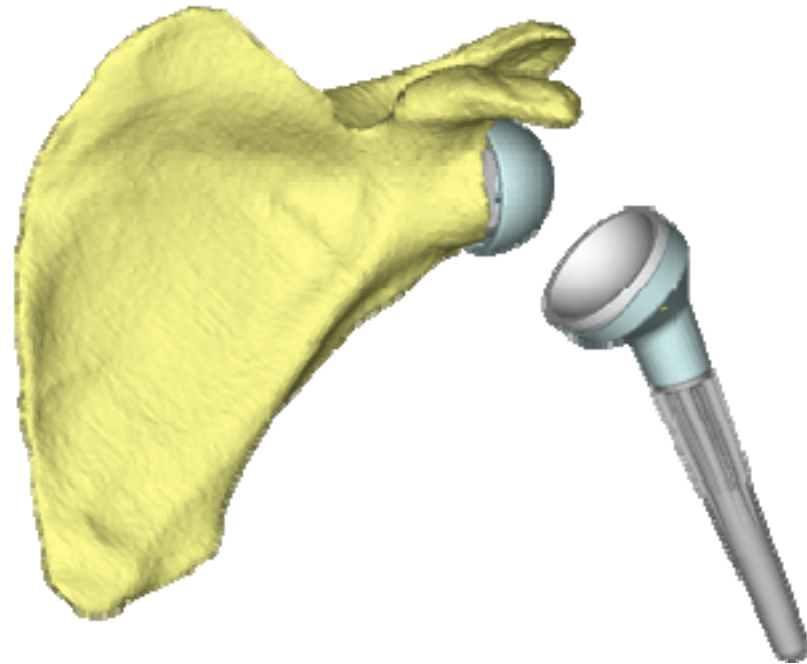
LE PRIME COMPLICANZE DELLA PROTESI TOTALE INVERSA: NOTCHING E INSTABILITA

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Protesi Inversa

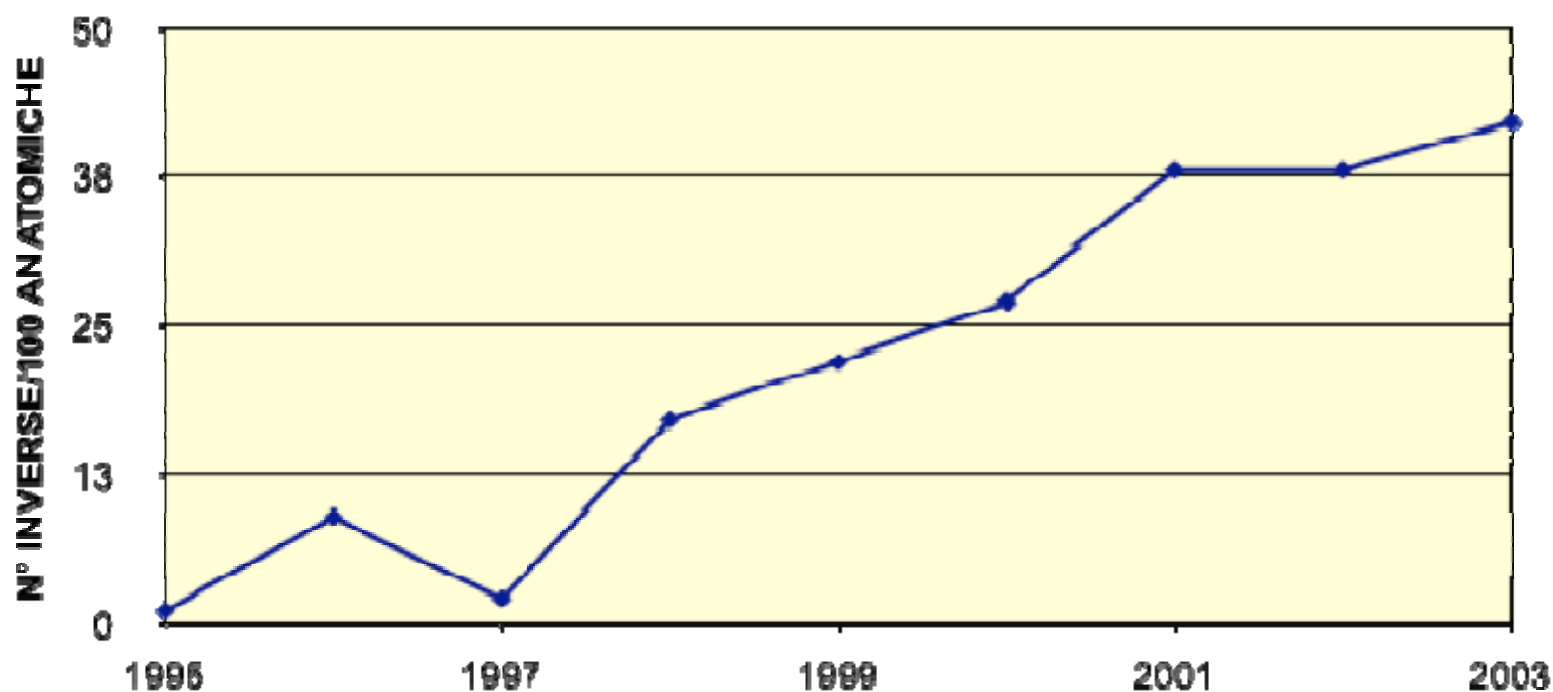
(Reverse Shoulder Prosthesis)

- RSP è una protesi totale caratterizzata dall'inversione dell'articolazione gleno-omeroale
 - Convessità nella glenoide
 - Concavità nell'omero



Trend della RSP

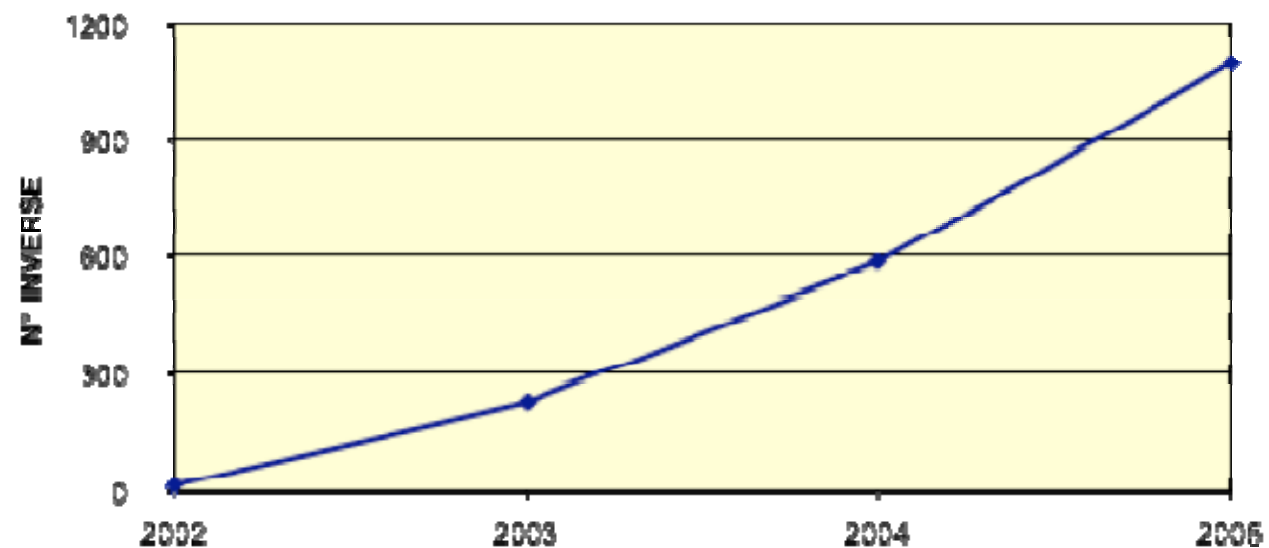
Inverse ogni 100 Anatomiche (1995-2003)
(D. Molè, 2004)



Protesi di Spalla Inversa (RSP)

- La RSP è sempre più usata per:
- CTA, Rotture massive di cuffia, Revisioni e Traumi acuti negli anziani

Impianti SMR/ anno



Indicazioni della RSP

- CTA (Cuff Tear Arthropathy)
- Revisioni di precedenti impianti
- Rottura massiva di cuffia con risalita dell'omero
- Artrosi eccentrica superiore
- Traumi acuti negli anziani
- Tumori



Caratteristica comune:

Mancanza di funzionalità della Cuffia dei Rotatori
con deltoide valido

Complicanze



Glenoid notching
44%

10%
Instabilità

REVIEW

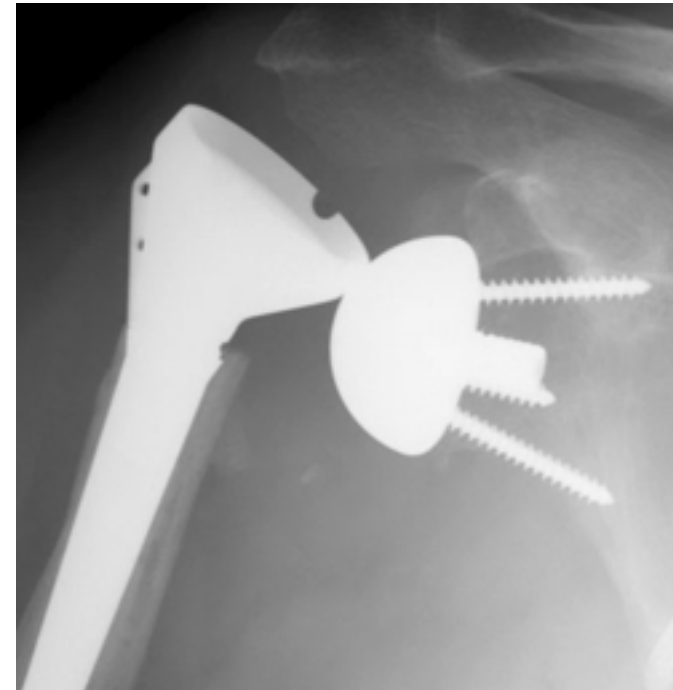
Reverse Total Shoulder Arthroplasty

JOAQUIN SANCHEZ-SOTELO*

The Department of Orthopedic Surgery, Mayo Clinic and Mayo Medical School, Rochester, Minnesota

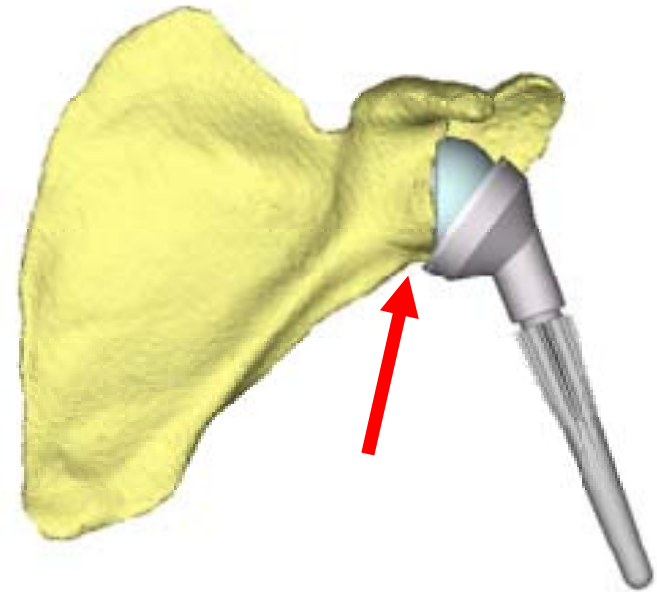
Reverse total shoulder arthroplasty designs have gained popularity over the last few years due to their satisfactory functional results in patients with cuff-tear arthropathy and other difficult reconstructive shoulder problems. These semiconstrained prostheses improve stability and active elevation in the absence of a functional rotator cuff by coupling a spherical glenoid component with a concave humeral component and increasing deltoid tension. Understanding the anatomy of the shoulder is critical in order to ensure secure fixation of the glenoid component, explore uncemented options for humeral component fixation, and determine the ideal soft-tissue tension to provide the best functional outcome without increasing the risk of complications. Key anatomic elements to be considered for the successful implantation of a reverse prosthesis include the orientation and size of the glenoid vault, the scapular regions with better bone stock (coracoid, spine of the scapula), the internal geometry of the humeral medullary canal, and the effects of reverse arthroplasty on the deltoid and brachial plexus. *Clin. Anat.* 22:172-182, 2009. © 2009 Wiley-Liss, Inc.

Key words: shoulder; arthroplasty; rotator cuff; arthropathy



Lo Scapular Notch

- Lo scapular notch è la più preoccupante complicazione a lungo termine delle protesi inverse
- Avviene per usura del polietilene che sfrega contro la scapola (prevalentemente in basso, ma anche posteriormente)
- 78% dei casi a 5 anni (D. Molè, Nice 2004)



Classificazione

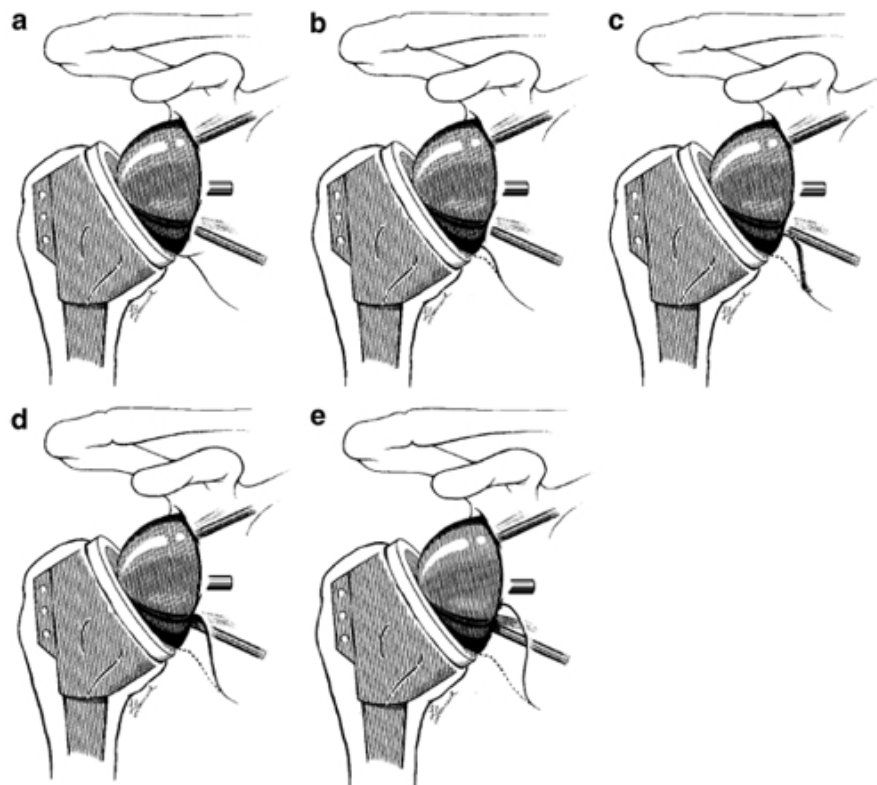


TABLE I Nerot[®] Grading System for Inferior Scapular Notching

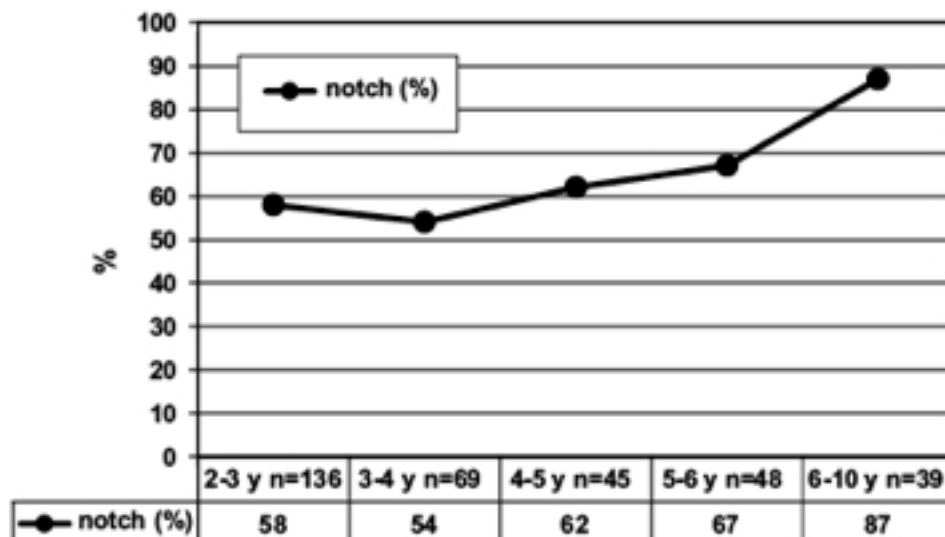
Grade 0	No notch
Grade 1	Erosion of lateral pillar only (small notch)
Grade 2	Erosion of lateral pillar with sclerotic margins, indicating stability
Grade 3	Erosion beyond inferior screw, indicating evolution
Grade 4	Erosion under metaglene baseplate as first sign of loosening



Quando valutarlo ?

Variable	6 weeks	12 months	24 months	36 months
Shoulders, No.	100	191	164	100
No notch, %	90	58	49	36
Grade 1, %	5	28	26	19
Grade 2, %	3	8	12	22
Grade 3, %	2	6	10	17
Grade 4, %	0	<1	3	6
Total notch, %	10	42	51	64

Follow up medio



Follow up lungo

Scapular notching in reverse shoulder arthroplasty

Christophe Léveigne, MD,^a Pascal Boileau, MD,^b Luc Favard, MD,^c Pascal Garaud, PhD,^d Daniel Molé, MD,^e François Sirveaux, MD,^a and Gilles Walch, MD,^f Lyon, Nice, Tours, and Nancy, France

The causes and consequences of scapular notching after reverse shoulder arthroplasty (RSA) were investigated in 326 consecutive patients (337 shoulders) undergoing RSA between 1991 and 2003. Patients underwent 269 (80%) primary RSAs and 68 revisions of unconstrained shoulder prosthesis. At last follow-up (average, 47 months; range, 24-120 months) 62% had scapular notching. Notching frequency and extension were correlated to the length of follow-up ($P = .0005$). Notching was more frequent in cuff tear arthropathy ($P = .0004$), grade 3 or 4 fatty infiltration of the infraspinatus ($P = .01$), and narrowed acromioclavicular distance ($P < .0001$). Glenoids preoperatively oriented superiorly were more at risk for notching ($P = .006$). More notching occurred when the RSA was implanted using an anterosuperior approach vs a deltopectoral approach ($P < .0001$). Notching was correlated with humeral radiolucencies in proximal zones ($P < .0001$) and with glenoid radiolucency lines ($P < .0001$). Positioning of the baseplate definitely influences scapular notching. High positioning of the baseplate and superior filling must be avoided. (*J Shoulder Elbow Surg* 2008;17:925-935.)

Reverse shoulder arthroplasty, following the biomechanical concept of Grammont, has proven to be an effective surgical method to improve pain and function in arthropathies associated with rotator cuff deficiency in short and midterm follow-up.^{1,2,4,6,8,14,16,21,23,25,27} However, the frequency of scapular notching, likely related to mechanical impingement by the medial rim of the humeral cup against the scapular neck in adduction, is of concern and has been suggested as a cause of glenoid loosening.^{4,7,8,23,24}

From ^aClinique du Parc and ^bClinique Sainte Anne Lumière, Lyon; ^cCentre Hospitalier de l'Archet, Nice; ^dCentre Hospitalier de Tours and ^eUnité de Statistiques Médicales, Tours; and ^fClinique de Traumatologie de Nancy, Nancy.

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Grammont and Baulot did not report this phenomenon in their publications.^{1,2,14} Others have observed glenoid loosening in rheumatoid arthritis but did not relate the problem to notching but rather to the porous rheumatoid bone.^{20,28} The diagnosis can be difficult because the defect is frequently hidden by the prosthesis. As such, one of our goals was to improve the radiographic assessment of the notch. To our knowledge, the first to report scapular notching was Sirveaux in 1997 in his medical thesis, supervised by Molé, reviewing a series of 42 Grammont prostheses.²¹ De Wilde² in 2001 reported 1 case in a series of 5. Since these observations, numerous authors have reported their personal experience with this phenomenon.^{3,4,7,9,16,17,21,23,24,27} Some have published cases of complete glenoid loosening obviously related to the extension of the scapular notch and discontinued their use of this prosthesis.^{7,23} Our purpose was to identify the causes and consequences of notching in a large series in order to propose some ways to avoid it.

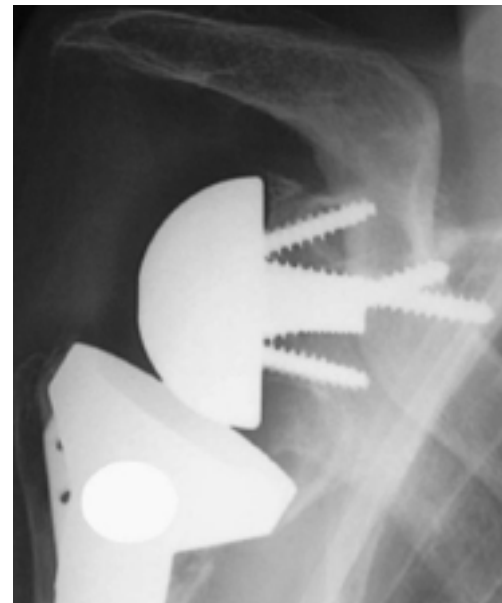
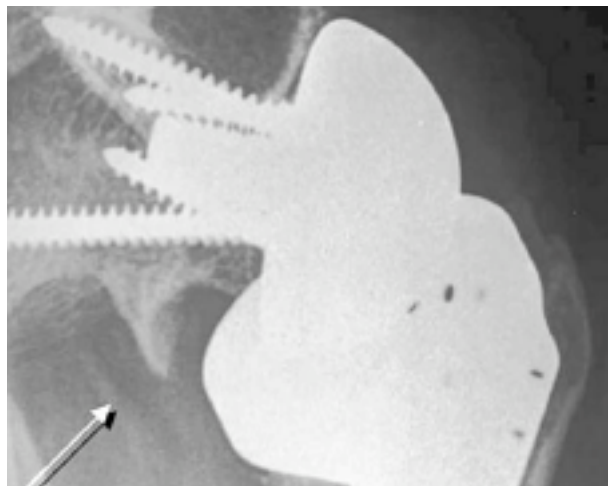
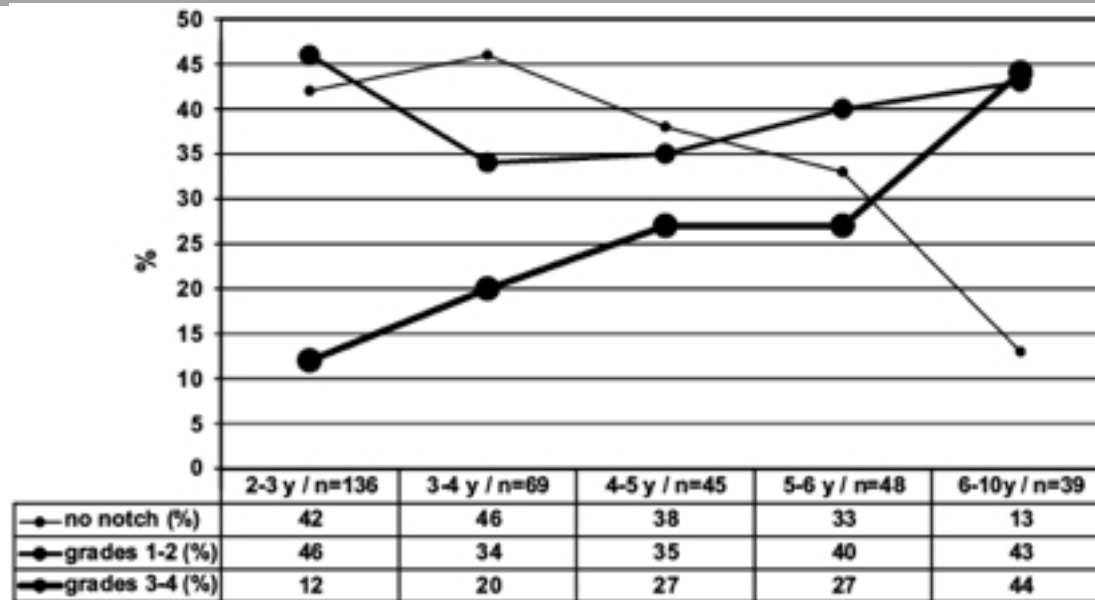
MATERIAL AND METHODS

Between December 1991 and June 2003, 457 consecutive shoulders in 430 patients were treated with reverse shoulder arthroplasty in four specialized shoulder surgery centers. Ten shoulders were excluded because the prosthesis was a revision of a previous reverse arthroplasty. Fifty-six shoulders were excluded because they were lost to follow-up without adequate postoperative radiographic documentation. Fifty-four shoulders were excluded because of radiographic follow-up shorter than 24 months. The study included 337 shoulders in 326 patients (64 men and 262 women) with an average age of 72 years (range, 18-87 years); of these, 64% were sedentary, and 36% were active and involved in professional or leisure activities. A total of 269 shoulders (80%) were primary arthroplasty cases, but 39 had undergone a previous operation (biceps tenotomy, acromioplasty, or cuff repair), and 68 were non-constrained prosthetic revision cases. Etiologies are summarized in Table 1.

Preoperative clinical assessment included the Constant score,² passive and active mobility in forward flexion, abduction, external rotation with the elbow at the side (ER1), external rotation combined with 90° of abduction (ER2), and internal rotation.

Preoperative radiographic evaluation was performed using true anteroposterior (AP) views in neutral rotation. The acromioclavicular distance was measured as the distance

Quando valutarlo ?



Scapular notching in reverse shoulder arthroplasty

Christophe Léveque, MD,* Pascal Boileas, MD,* Luc Favard, MD,* Pascal Garaud, PhD,* Daniel Molé, MD,* François Sireaux, MD,* and Gilles Walch, MD,* Lyon, Nice, Tours, and Nancy, France

The causes and consequences of scapular notching after reverse shoulder arthroplasty (RSA) were investigated in 328 consecutive patients (337 shoulders) undergoing RSA between 1991 and 2003. Patients underwent 269 (80%) primary RSAs and 68 revisions of unconstrained shoulder prostheses. At last follow-up (average, 47 months; range, 24-120 months) 62% had scapular notching. Notching frequency and extension were correlated to the length of follow-up ($P = .0005$). Notching was more frequent in cuff tear arthroplasty ($P = .0004$), grade 3 or 4 fatty infiltration of the infraspinatus ($P = .01$), and narrowed acromioclavicular distance ($P < .0001$). Glenoids postoperatively oriented superiorly were more at risk for notching ($P = .006$). More notching occurred when the RSA was implanted using an anteroposterior approach vs a deltopectoral approach ($P < .0001$). Notching was correlated with humeral radiolucencies in proximal zones ($P < .0001$) and with glenoid radiolucency lines ($P < .0001$). Positioning of the baseplate definitely influences scapular notching. High positioning of the baseplate and superior filling must be avoided. (J Shoulder Elbow Surg 2008;17:925-935.)

Reverse shoulder arthroplasty, following the biomechanical concept of Grammont, has proven to be an effective surgical method to improve pain and function in arthropathies associated with rotator cuff deficiency in short and mid-term follow-up.^{1,2,4,6,8,14,15,21,23,25,32} However, the frequency of scapular notching, likely related to mechanical impingement by the medial rim of the humeral cup against the scapular neck in adduction, is of concern and has been suggested as a cause of glenoid loosening.^{4,7,8,23,34}

From *Clinique de Paris and *Clinique Sainte Anne Limière, Lyon; *Centre Hospitalier de l'Arche, Nice; *Centre Hospitalier de Sion and *Unité de Soins Médicaux, Tours; and *Clinique de Traumatologie de Nancy, France.
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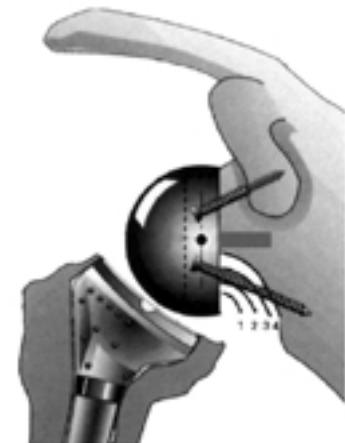
Grammont and Baulot did not report this phenomenon in their publications.^{1,2,14} Others have observed glenoid loosening in rheumatoid arthritis but did not relate the problem to notching but rather to the porotic rheumatoid bone.²⁴ The diagnosis can be difficult because the defect is frequently hidden by the prosthesis. As such, one of our goals was to improve the radiographic assessment of the notch. To our knowledge, the first to report scapular notching was Sireaux in 1997 in his medical thesis, supervised by Molé, reviewing a series of 42 Grammont prostheses.³¹ De Wilde¹⁰ in 2001 reported 1 case in a series of 5. Since these observations, numerous authors have reported their personal experience with this phenomenon.^{3,4,7,8,14,19,21,23,24,30} Some have published cases of complete glenoid loosening obviously related to the extension of the scapular notch and discontinued their use of this prosthesis.^{7,22} Our purpose was to identify the causes and consequences of notching in a large series in order to propose some ways to avoid it.

MATERIAL AND METHODS

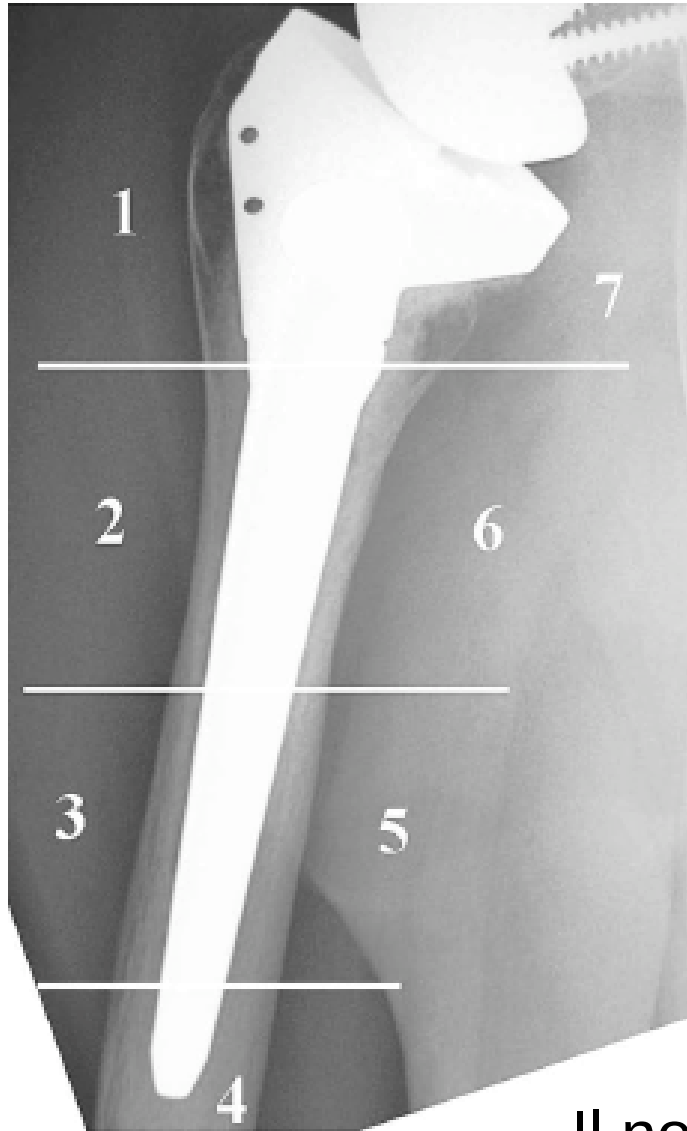
Between December 1991 and June 2003, 457 consecutive shoulders in 430 patients were treated with reverse shoulder arthroplasty in four specialized shoulder surgery centers. Ten shoulders were excluded because the prosthesis was a revision of a previous reverse arthroplasty. Fifty-four shoulders were excluded because they were lost to follow-up without adequate postoperative radiographic documentation. Fifty-four shoulders were excluded because of radiographic follow-up shorter than 24 months. The study included 337 shoulders in 328 patients (164 men and 205 women) with an average age of 72 years (range, 18-87 years); of these, 64% were sedentary, and 35% were active and involved in professional or leisure activities. A total of 269 shoulders (80%) were primary arthroplasty cases, but 39 had undergone a previous operation (large tenotomy, acromioplasty, or cuff repair), and 68 were non-constrained prosthetic revision cases. Etiologies are summarized in Table 1.

Postoperative clinical assessment included the Constant score,³⁵ passive and active mobility in forward flexion, abduction, external rotation with the elbow at the side [E1], external rotation combined with 90° of abduction [E2], and internal rotation.

Preoperative radiographic evaluation was performed using true anteroposterior (AP) views in neutral rotation. The acromioclavicular distance was measured as the distance



Quando valutarlo ?



Status notch	No notch	Grade 1	Grade 2	Grade 3	Grade 4
Shoulders, No.	127	75	62	47	26
Lucent glenoid line, %	4	1	19	28	12

Il notch glenoideo è fortemente correlato alla presenza di linee di radiolucenza

Scapular notching in reverse shoulder arthroplasty

Christophe Lejeune, MD,* Pascal Boileau, MD,* Luc Favard, MD,* Pascal Gossard, MD,* Daniel Molli, MD,* François Simeoni, MD,* and Gilles Walch, MD,* Lyon, Paris, Bordeaux, and Nancy, France

The causes and consequences of scapular notching after reverse shoulder arthroplasty (RSA) were investigated in 235 consecutive patients (237 shoulders) undergoing RSA between 1991 and 2003. Patients underwent 209 (89%) primary RSAs and 28 (12%) revisions of uniconstrained shoulder prostheses. At last follow-up (average, 47 months; range, 24-120 months) 62% had scapular notching. Notching frequency and extension were correlated to the length of follow-up ($P = .0005$). Notching was more frequent in cuff tear arthroplasty ($P = .0004$), grade 3 or 4 fatty infiltration of the subscapularis ($P = .01$), and increased acromion-humeral distance ($P < .0001$). Glenoids preoperatively oriented superiorly were more at risk for notching ($P = .0001$). More notching occurred when the RSA was implanted using an anatomic approach in a deltoid-sparing approach ($P < .0001$) and with glenoid radiolucency line ($P < .0001$). Fracturing of the humerus definitely influences scapular notching. High positioning of the humeral and superior filling must be avoided. (*J Shoulder Elbow Surg* 2008;17:925-935.)

Reverse shoulder arthroplasty, following the biomechanical concept of Grammont, has proven to be an effective surgical method to improve pain and function in arthroplasties associated with cuff tear deficiency, rotator cuff and massive tuberosity tears, and massive tuberosity tears. However, the frequency of scapular notching, likely related to mechanical impingement by the medial rim of the humeral cup against the scapular neck in adduction, is of concern and has been suggested as a cause of glenoid loosening.^{1-3,11,12}

From *Clinique de Paris and Clinique Sainte Anne Lourdes, Lyon; *Clinique Hospital de France, Lyon; *Clinique Hospital de Paris and *Clinique de Saint-Joseph, Paris; and *Clinique de Saint-Joseph, Paris. Received for publication April 15, 2008; accepted for publication May 15, 2008. Copyright © 2008 by Journal of Shoulder and Elbow Surgery. 1058-2746/08/1708-925\$10.00. doi:10.1016/j.jse.2008.02.010

Grammont and Boulet did not report this phenomenon in their publications.^{13,14} Others have observed glenoid loosening in increased efforts but did not relate the problem to notching but rather to the possible rheumatoid factor.¹⁵ The diagnosis can be difficult because the defect is frequently hidden by the prosthesis. As such, one of our goals was to improve the radiographic assessment of the notch. To our knowledge, the first to report scapular notching was Swenson in 1997 in his medical thesis, supervised by Molli, reviewing a series of 42 Grammont prostheses.¹⁶ De Wilde¹⁷ in 2001 reported 1 case in a series of 15. Since these observations, numerous authors have reported their experience with this phenomenon.¹⁸⁻²³ Some have published cases of complete glenoid loosening clinically related to the extension of the scapular notch and discontinued their use of this prosthesis.²⁴ Our purpose was to identify the causes and consequences of notching in a large series in order to propose some ways to avoid it.

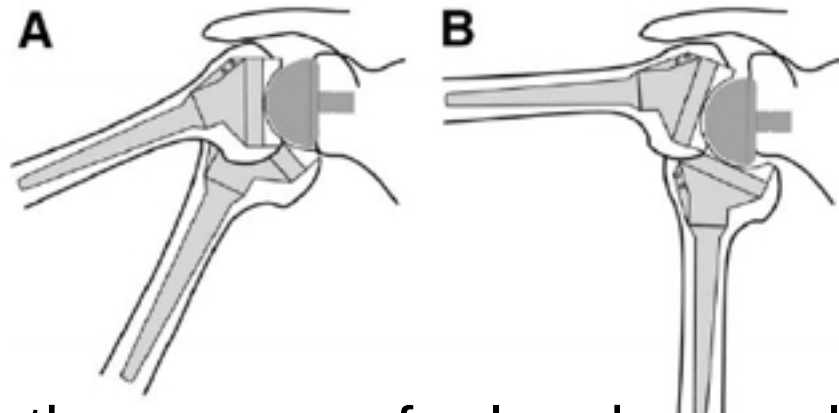
MATERIAL AND METHODS

Between December 1991 and June 2003, 437 consecutive shoulders in 430 patients were treated with reverse shoulder arthroplasty in two specialized shoulder surgery centers. Ten shoulders were excluded because they were not a revision of a previous reverse arthroplasty. Thirteen shoulders were excluded because they were lost to follow-up after clinical and radiographic follow-up. The revision series. Hyaline shoulders were excluded because of radiographic follow-up shorter than 24 months. The study included 337 shoulders in 324 patients (181 men and 143 women) with an average age of 72 years (range, 18-87 years); of these, 64% were secondary, and 35% were primary or revision of a previous arthroplasty. A total of 269 shoulders (80%) were primary arthroplasty cases, but 39 had undergone a previous operation (biceps tenotomy, coracoclavicular or cuff repair, and 48 were non-constrained prostheses revision cases). Dislocations were extremely rare (1 case).

Preoperative clinical assessment included the Constant score,²⁵ passive and active mobility by forward flexion, abduction, external rotation with the elbow at the side (ER), external rotation combined with 90° of abduction (ER2), and internal rotation.

Postoperative radiographic evaluation was performed using two anteroposterior (AP) views in neutral rotation. The acromion-humeral distance was measured on the distance

Clinicamente evidente?



“...the range of glenohumeral motion of a reverse shoulder prosthesis depends on the position of the glenoid implant. Placing the glenoid component 2 to 4 mm more distally than recommended significantly improves abduction and adduction angles and reduce the risk of inferior glenoid notching...”

Biomechanical relevance of glenoid component positioning in the reverse Delta III total shoulder prosthesis

Richard W. Hefke, MD,¹ Oliver M. L. Wieser, MD,² and Christian Gähle, MD,² Lucerne and Zurich, Switzerland

The presence of a notch at the inferior part of the scapular neck is a common radiographic finding in patients treated with a reverse Delta III shoulder prosthesis. It is thought that this notch is a result of mechanical contact between the polyethylene cup of the humeral implant and the inferior glenoid pole during abduction of the arm. This in vitro study assessed the effect of glenoid component positioning on glenohumeral range of motion in 8 shoulder specimens. Four different positions of the glenosphere were tested: glenosphere centered on the glenoid, leaving the inferior glenoid rim uncovered (configuration A); glenosphere flush with the inferior glenoid rim (configuration B); glenosphere extending beyond the inferior glenoid rim (configuration C); and glenosphere tilted downward 15° (configuration D). The respective mean abduction and adduction angles in the scapular plane were: -25° and 87° for configuration A, -14° and 68° for configuration B, -1° and 81° for configuration C, and -9° and 75° for configuration D. Placing the glenosphere distally (not configuration C) significantly improved abduction and adduction angles compared with all other test configurations ($P < .001$). *J Shoulder Elbow Surg* 2008;14:524-528.

The treatment of patients with arthritis of the shoulder and irreparable tears of the rotator cuff is difficult. Superior migration of the humeral head results in excessive superior loading of the glenoid and is a relative contraindication for conventional (anatomical) total shoulder replacement. Reverse total shoulder replacement may reduce joint reaction forces, however, is limited as a result of the lack of rotator cuff function, and there is a risk of erosion of the

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incision and glenoid by the humeral component. In 1987 Gossamer et al¹ described a semi-constrained total shoulder prosthesis that reverses the scapular and humeral components (Delta III total shoulder prosthesis; DePuy International Ltd, Leeds, England). Early results of treatment of arthritic shoulders with rotator cuff deficiency with this prosthesis have been encouraging with regard to pain relief and improvement of function.²⁻⁴ A major concern remains regarding the formation of a notch at the inferior pole of the scapular neck⁵ (Figure 1), a possible source of mechanical failure. It is thought that this notch is related to the design of the prosthesis (Figure 2) and a result of mechanical contact between the polyethylene of the applied implant and the glenoid during abduction of the arm, resulting in polyethylene wear, chronic inflammation of the joint capsule, and local osteolysis.⁶

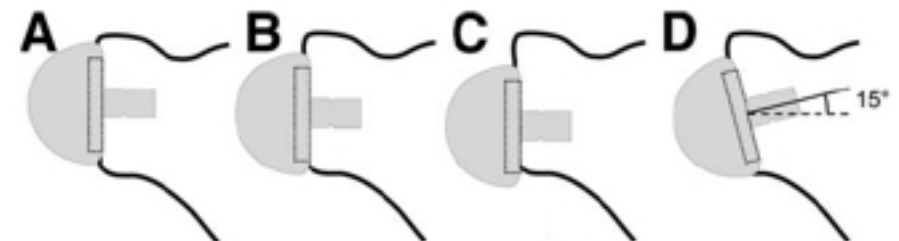
It is hypothesized that the mechanical contact at the inferior scapular neck must be related to the placement of the glenoid prosthesis and that the recommendation of the manufacturer may be incorrect. The purpose of this study was, therefore, to assess the influence of glenoid component positioning on glenohumeral range of motion and mechanical impingement between the prosthesis and the glenoid.

MATERIALS AND METHODS

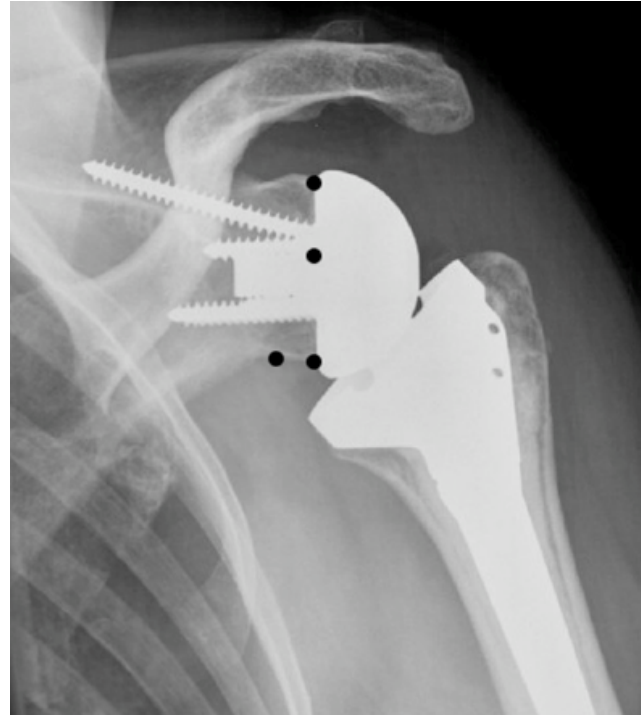
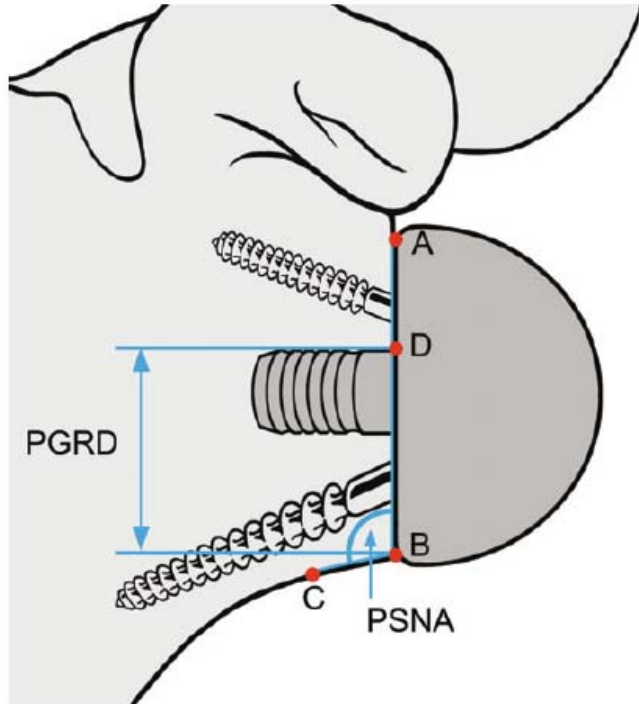
A total of 8 fresh frozen human shoulder specimens were obtained from the Department of Pathology of our university. There were 5 right and 3 left shoulders consisting of the whole scapula and the proximal half of the humerus. After thawing, all muscles, tendons, and ligaments were stripped off. Special attention was paid to clean the inferior glenoid pole and the tuberosity of any soft tissue. The components and ligament were carefully preserved. Gross inspection did not show any posttraumatic deficiency or degenerative changes with no glenoid wear. The articular cartilage of the glenoid was removed with a curette, and the circumferential and anteroposterior diameters of the bony glenoid were measured with a caliper.

Preparation of humerus

The humeral head was cut by use of the resection guide. Normal resection of the specimen was not changed. The metaphysis and medullary canal were prepared by use of the appropriate-sized reamers. Flaming was completed



Come predirlo ?



Predictors of Scapular Notching in Patients Managed with the Delta III Reverse Total Shoulder Replacement

By Ryan W. Smolovich, MD, Matthias A. Zanetti, MD, Erilene Lohr, MD, Naeder Helmy, MD, and Christian Gerber, MD, FRCSEd

Investigation performed at the Department of Orthopaedics, University of Zurich, CHUV, Switzerland

Background: The reverse Delta III shoulder prosthesis can relieve pain and restore function in patients with cuff tear arthropathy. The most frequently reported radiographic complication is inferior scapular notching. The purpose of the present study was to evaluate the clinical relevance of notching and to determine the anatomic and radiographic parameters that predispose to its occurrence.

Methods: Seventy-seven consecutive shoulders in seventy-six patients with an irreparable rotator cuff deficiency were managed with a reverse Delta III shoulder arthroplasty and were followed clinically and radiographically for a minimum of twenty-four months. The effects of cranial-caudal glenoid component positioning and the prosthesis-scapular neck angle on the development of inferior scapular notching and clinical outcome were assessed.

Results: All shoulders that had development of notching did so in the first fourteen months. Of the seventy-seven shoulders that were studied, thirty-four (44%) had inferior scapular notching, twentythree (30%) had posterior notching, and six (8%) had anterior notching. Osteophytes along the inferior part of the scapula occurred in twentyone (27%) of the seventy-seven shoulders. The angle between the glenosphere and the scapular neck ($p = 0.007$) as well as the cranio-caudal position of the glenosphere ($p = 0.054$) were highly correlated with inferior notching ($p < 0.0001$). A notching index was calculated with use of the height of implantation of the glenosphere and the postoperative prosthesis-scapular neck angle. This allowed prediction of the occurrence of notching with a sensitivity of 91% and specificity of 88%. The height of implantation of the glenosphere had approximately an eight times greater influence on inferior notching than the prosthesis-scapular neck angle did. Inferior scapular notching was associated with a significantly poorer clinical outcome.

Conclusion: Inferior scapular notching after reverse total shoulder arthroplasty adversely affects the intermediate-term clinical outcome. It can be prevented by optimal positioning of the glenoid component.

Level of Evidence: Prognostic Level II. See Instructions to Authors for a complete description of levels of evidence.

Early attempts to treat glenohumeral arthritis associated with advanced rotator cuff disease were not proven to be clinically satisfactory. Conventional total shoulder arthroplasty was associated with early loosening and subsequent failure of the glenoid component due to the rocking bone mechanism. In an attempt to improve function and prosthetic longevity, constrained and semiconstrained prostheses were introduced, but instability, unsatisfactory active mobility, and early glenoid component loosening led surgeons to abandon constrained prostheses and to return to hemiarthroplasty, which, however, did not yield the desired functional results.¹⁻⁴

In 1985, the Delta III reverse prosthesis was introduced by Grammont.⁵ This prosthesis features a semiconstrained inverted design with a fixed, lowered, and medialized center of rotation. By medializing and lowering the center of rotation, the reverse prosthesis decreases shear forces at the glenoid component-bone interface, improves the lever arm of the deltoid, and results in improved survival compared with other constrained and semiconstrained designs.^{6,7}

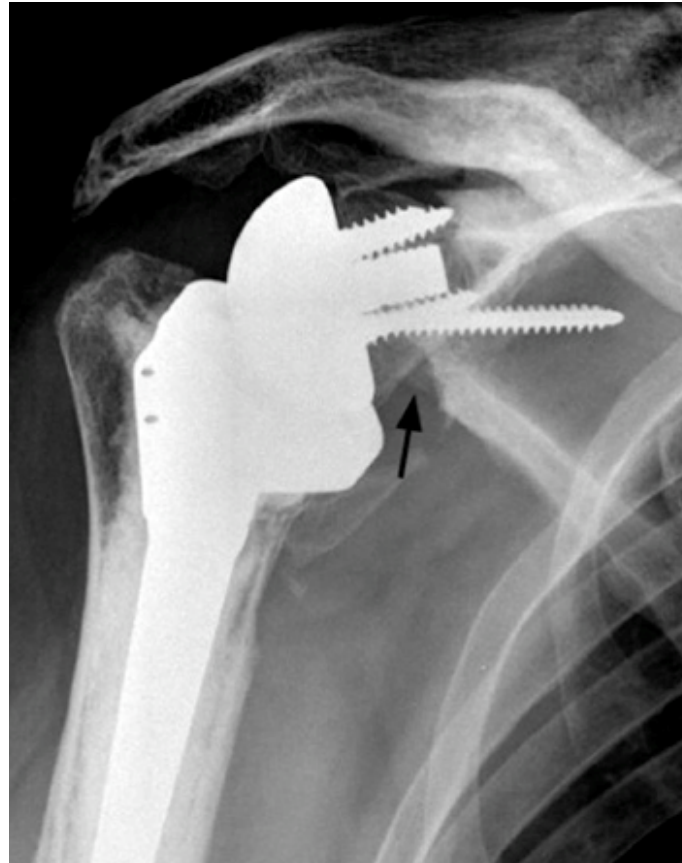
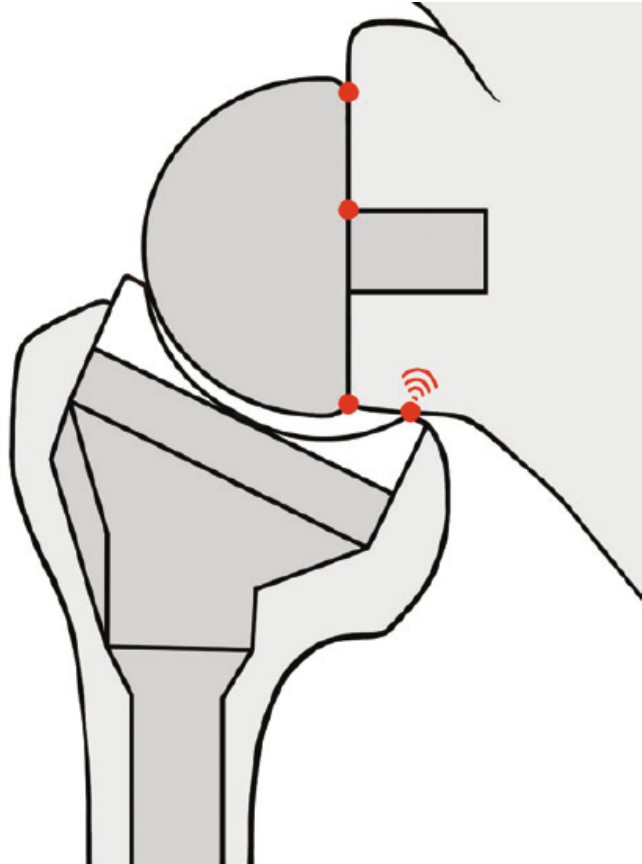
Disclosure: In support of their research for or preparation of this work, one or more of the authors received, in any one year, outside funding or grants in excess of \$10,000 from the Naef Foundation (Zürich, Switzerland) and a number of their immediate families received payments or other benefits or a commitment or agreement to provide such benefits from a commercial entity. No commercial entity paid or directed, or agreed to pay or direct, any benefits to any research fund, foundation, institution, center, clinical practice, or other charitable or nonprofit organization with which the authors, or a member of their immediate families, are affiliated or associated.

TABLE II Mean Values for the Prosthesis-Scapular Neck Angle, Delta Scapular Neck Angle, and Peg-Glenoid Rim Distance in Shoulders With and Without Notching

Measurement	No Inferior Notching*	Inferior Notching*	P Value†
Prosthesis-scapular neck angle	93° ± 15° (67° to 123°)	124° ± 19° (74° to 156°)	<0.001
Delta scapular neck angle	9° ± 15° (-21° to 54°)	31° ± 25°, (-12° to 79°)	<0.001
Peg-glenoid rim distance	20.1 ± 2.5 (13 to 25)	24.7 ± 3 (19 to 30)	<0.001

Abbassare la metaglena per diminuire il PGRD

Come predirlo ?



↑ PGRD = Notching

Predictors of Scapular Notching in Patients Managed with the Delta III Reverse Total Shoulder Replacement

By Ryan W. Smolovich, MD, Matthias A. Zanetti, MD, Erland Lohr, MD, Nader Helmy, MD, and Christian Gerber, MD, FRCSEd

Investigation performed at the Departments of Orthopaedics, University of Zürich, CHUV, and University of Zürich, Switzerland

Background: The reverse Delta III shoulder prosthesis can relieve pain and restore function in patients with cuff tear arthropathy. The most frequently reported radiographic complication is inferior scapular notching. The purpose of the present study was to evaluate the clinical relevance of notching and to determine the anatomic and radiographic parameters that predispose to its occurrence.

Methods: Seventy-seven consecutive shoulders in seventy-six patients with an irreparable rotator cuff deficiency were managed with a reverse Delta III shoulder arthroplasty and were followed clinically and radiographically for a minimum of twenty-four months. The effects of cranial-caudal glenoid component positioning and the prosthetic-scapular neck angle on the development of inferior scapular notching and clinical outcome were assessed.

Results: All shoulders that had development of notching did so in the first fourteen months. Of the seventy-seven shoulders that were studied, thirty-four (44%) had inferior scapular notching, twentythree (30%) had posterior notching, and six (8%) had anterior notching. Osteophytes along the inferior part of the scapula occurred in twentyone (27%) of the seventy-seven shoulders. The angle between the glenosphere and the scapular neck ($p = 0.007$) as well as the cranio-caudal position of the glenosphere ($p = 0.054$) were highly correlated with inferior notching ($p < 0.0001$). A notching index was calculated with use of the height of implantation of the glenosphere and the postoperative prosthetic-scapular neck angle. This allowed prediction of the occurrence of notching with a sensitivity of 91% and specificity of 88%. The height of implantation of the glenosphere had approximately an eight times greater influence on inferior notching than the prosthetic-scapular neck angle did. Inferior scapular notching was associated with a significantly poorer clinical outcome.

Conclusion: Inferior scapular notching after reverse total shoulder arthroplasty adversely affects the intermediate-term clinical outcome. It can be prevented by optimal positioning of the glenoid component.

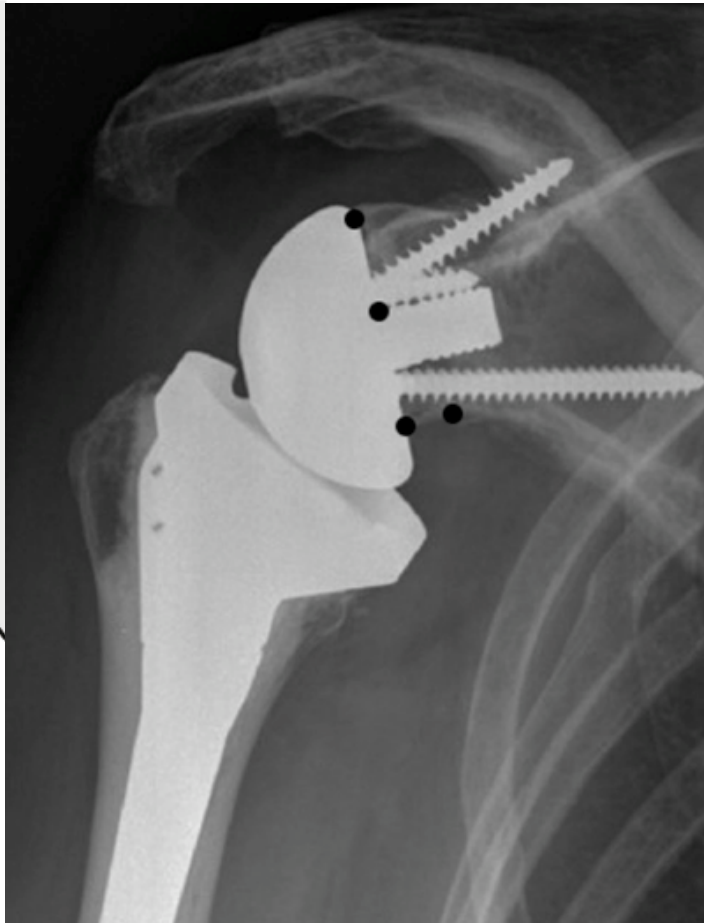
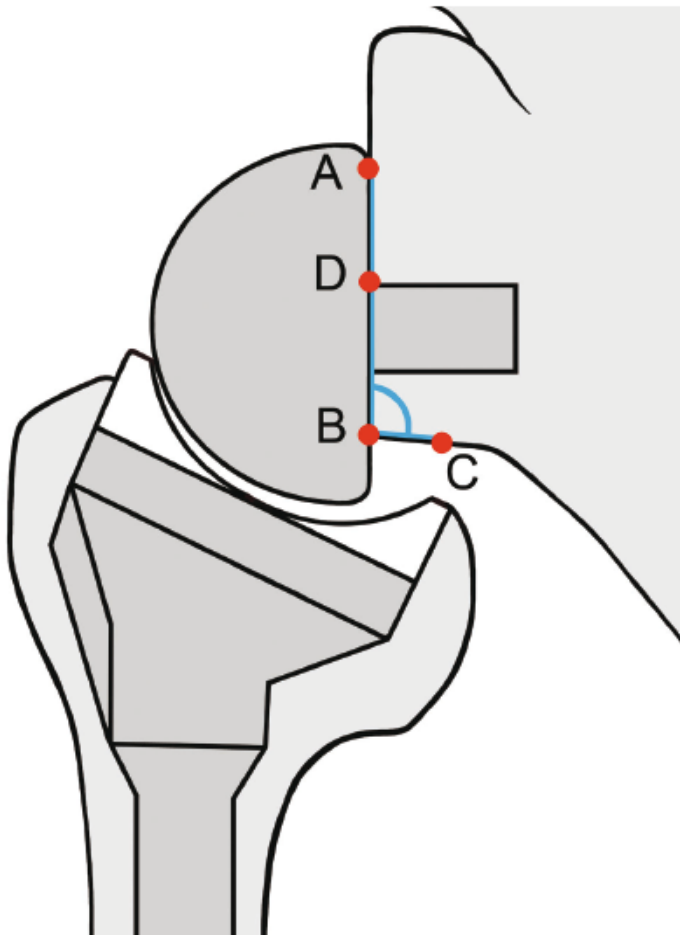
Level of Evidence: Prognostic Level II. See Instructions to Authors for a complete description of levels of evidence.

Early attempts to treat glenohumeral arthritis associated with advanced rotator cuff disease were not proven to be clinically satisfactory.¹⁻³ Conventional total shoulder arthroplasty was associated with early loosening and subsequent failure of the glenoid component due to the rocking bone mechanism.⁴⁻⁶ In an attempt to improve function and prosthetic longevity, constrained and semiconstrained prostheses were introduced, but instability, unsatisfactory active mobility, and early glenoid component loosening⁷ led surgeons to abandon constrained prostheses and to return to hemiarthroplasty, which, however, did not yield the desired functional results.^{8,9}

In 1985, the Delta III reverse prosthesis was introduced by Grammont.¹⁰ This prosthesis features a semiconstrained inverted design with a fixed, lowered, and medialized center of rotation. By medializing and lowering the center of rotation, the reverse prosthesis decreases shear forces at the glenoid component-bone interface, improves the lever arm of the deltoid, and results in improved survival compared with other constrained and semiconstrained designs.¹¹

Disclosure: In support of their research for or preparation of this work, one or more of the authors received, in any one year, outside funding or grants in excess of \$10,000 from the Swiss Foundation 2010. Neither they nor a member of their immediate families received payments or other benefits or a commitment or agreement to provide such benefits from a commercial entity. No commercial entity paid or directed, or agreed to pay or direct, any benefits to any research fund, foundation, institution, center, clinical practice, or other charitable or nonprofit organization with which the authors, or a member of their immediate families, are affiliated or associated.

Come predirlo ?



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Methods: Seventy-seven consecutive shoulders in seventy-six patients with an irreparable rotator cuff deficiency were managed with a reverse Delta III shoulder arthroplasty and were followed clinically and radiographically for a minimum of twenty-four months. The effects of cranial-caudal glenoid component positioning and the prostheso-scapular neck angle on the development of inferior scapular notching and clinical outcome were assessed.

Results: All shoulders that had development of notching did so in the first fourteen months. Of the seventy-seven shoulders that were studied, thirty-four (48%) had inferior scapular notching, twentythree (30%) had posterior notching, and six (8%) had anterior notching. Osteophytes along the inferior part of the scapula occurred in twentyone (27%) of the seventy-seven shoulders. The angle between the glenosphere and the scapular neck ($p = 0.007$) as well as the cranio-caudal position of the glenosphere ($r = 0.054$) were highly correlated with inferior notching ($p < 0.0001$). A notching index was calculated with use of the height of implantation of the glenosphere and the postoperative prostheso-scapular neck angle. This allowed prediction of the occurrence of notching with a sensitivity of 91% and specificity of 88%. The height of implantation of the glenosphere had approximately an eight times greater influence on inferior notching than the prostheso-scapular neck angle did. Inferior scapular notching was associated with a significantly poorer clinical outcome.

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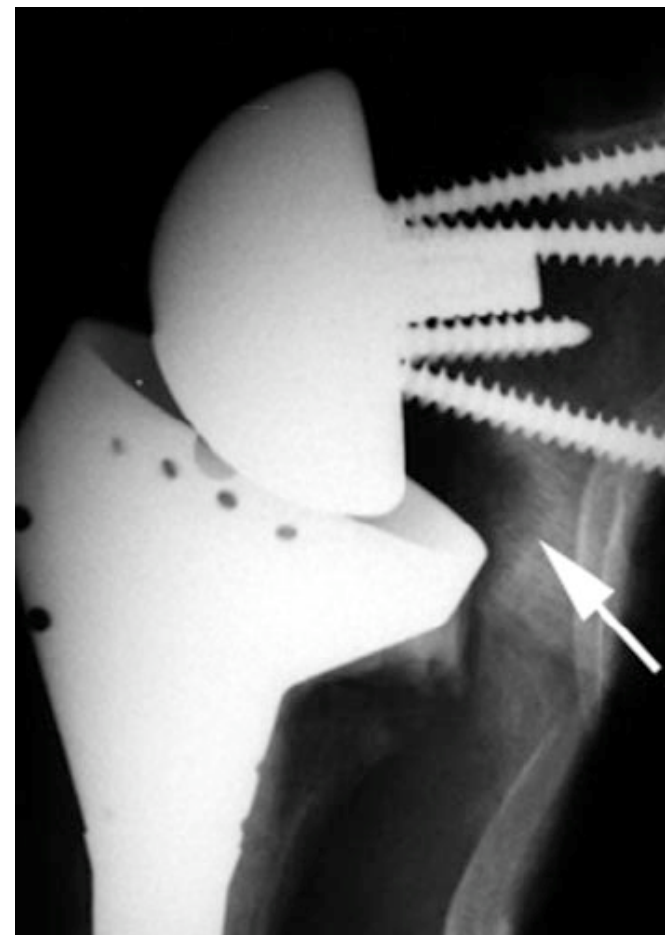
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Come predirlo ?



Notching



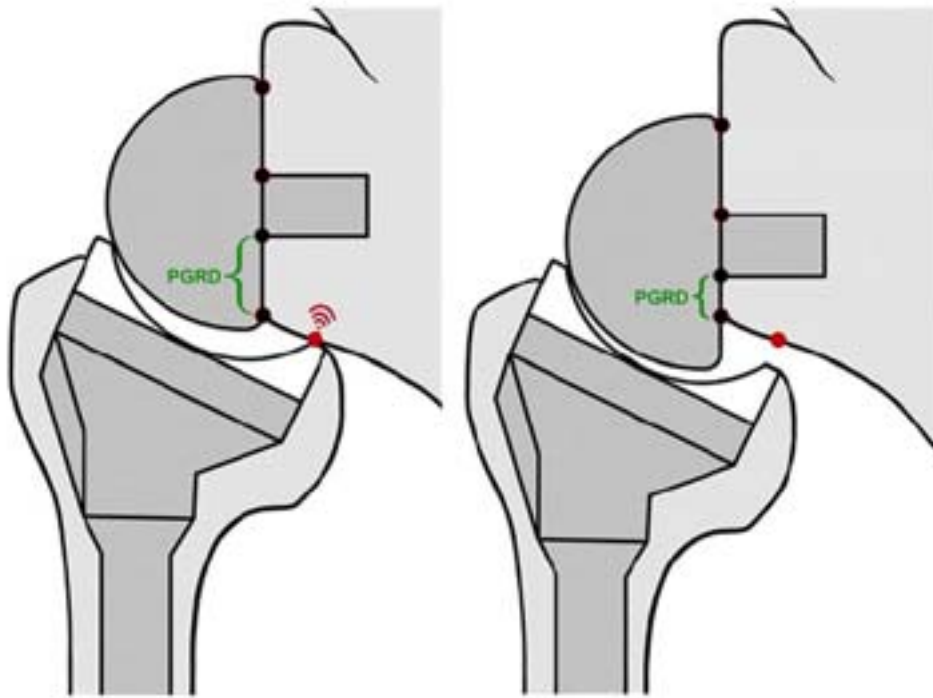
Eccessiva medializzazione del centro di rotazione

Come evitarlo?

- ☺ **Posizionare il Metal-Back sul bordo inferiore della glenoide**
- ☹ Il perno non è nella zona di massimo materiale osseo
- ☹ Può causare la fuoriuscita della vite inferiore



Come evitarlo?



“... use of a **target position 12 mm** above the inferior glenoid rim will result in a glenosphere position distal on the glenoid face. This position should reduce impingement and notching and may improve clinical success ...”

Optimizing glenosphere position and fixation in reverse-shoulder arthroplasty. Part One: The twelve-mm rule

James D. Nally, MD^{1,2}, Scott Hershberg, MD² and Lisa E. Harris, MD² San Francisco, CA, and Boston, MA

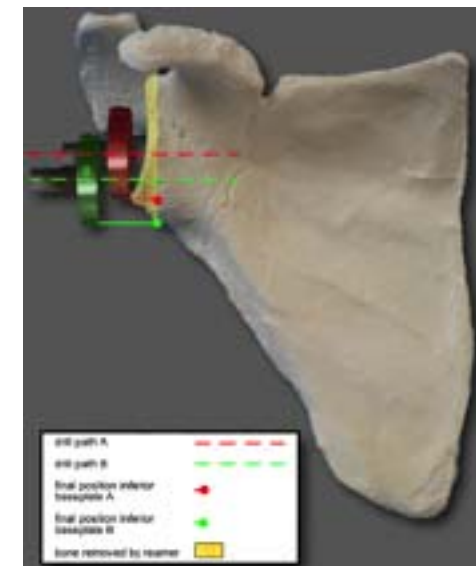
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The American Institute of Chemical Engineers (AIChE), Englewood, Cliffs, New Jersey, has announced plans to publish a new book, *Process Dynamics and Control*, in the near future. The book is a compilation of this journal and has been written by well-known contributors to the field of process dynamics and control. The book is intended to be a reference work for the chemical engineer and is expected to be published in the near future. The book is expected to be published in the near future.

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 doi:10.3182/jhered.2007.08.0010

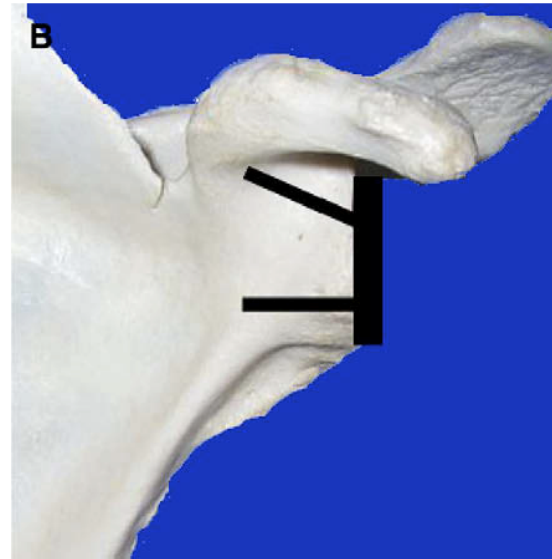
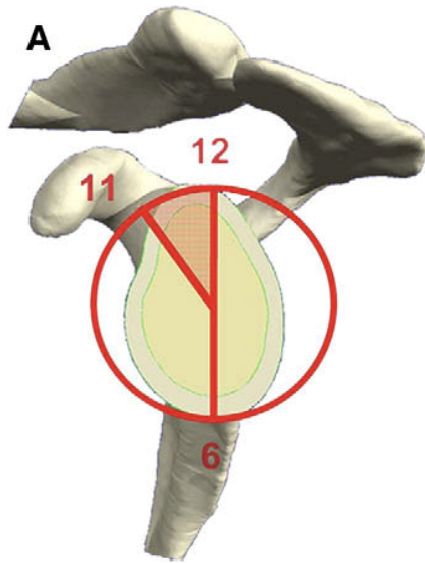
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The developmental computer program CT was used to generate and evaluate the optimal location of the transducer on the glenoid of each specimen. CT plotting was performed on 10 anatomical supplies, which were then placed with flexible wiring around the glenoid, humeral head, and scapula (lateral) according to the algorithm plan. The



Come evitare di posizionare la vite fuori ?

Vite superiore a cercare
la base della coracoide



Vite inferiore parallela
al fittone centrale

J Shoulder Elbow Surg (2009) ■, 1-6



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Optimal rotation and screw positioning for initial glenosphere baseplate fixation in reverse shoulder arthroplasty

Bradford O. Parsons, MD^a, Konrad I. Gruson, MD^b, Kenneth J. Accousti, MD^c,
Raymond A. Klug, MD^a, Evan L. Flatow, MD^{a,*}

^aLevi & Peter May Department of Orthopaedic Surgery, Mount Sinai School of Medicine, New York, NY

^bDepartment of Orthopaedic Surgery, Albert Einstein College of Medicine, Bronx, NY

^cFredericksburg Orthopaedic Associates, P.C., Fredericksburg, VA

Summary Critical to the longevity of the reverse shoulder arthroplasty is initial rigid fixation of the glenosphere, determined in part by baseplate screw fixation. Implants with a variable angle and a fixed-angle baseplate were done in 12 highly embossed adult scapulae. Baseplates were placed in 3 rotational positions: (1) 12/6 o'clock, (2) 20° rotation toward the coracoid, and (3) 20° rotation toward the scapular spine. Superiorly perpendicular screws for the variable-angle baseplate in the 12 o'clock (39.7 mm) and coracoid (37.7 mm) position and angled screws in the coracoid position (37.5 mm) were found to be the longest. Inferiorly, screws holes made perpendicular to the baseplate yielded the longest screw lengths (37.4 mm), whereas inferiorly angled screws were shorter, especially in the anterior-inferior glenoid (16.8 mm). Overall, baseplate rotation toward the spine yielded the longest mean screw lengths. Proper initial rotation of the baseplate and screw orientation can optimize initial fixation of the glenosphere in reverse shoulder arthroplasty.

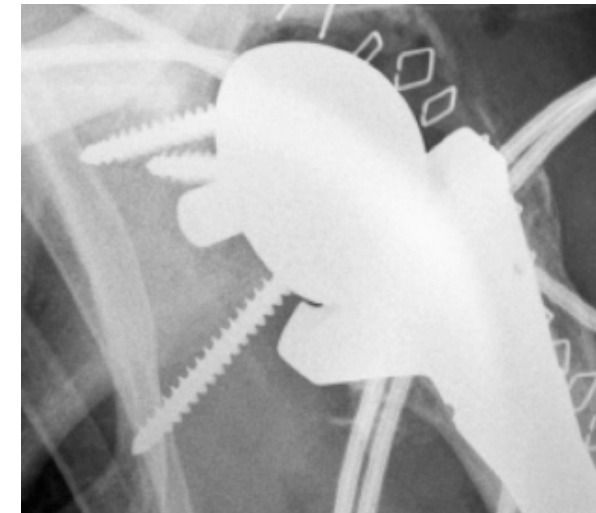
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Reverse shoulder arthroplasty (RSA) has advanced the treatment of painful cuff-deficient arthritic shoulders and has proved to be an option in properly selected patients.^{1,3,5,7,16,20} RSA offers remarkable improvement in shoulder elevation and function in older patients with symptomatic pseudoparalysis; however, many series have shown a higher complication rate associated with primary

and revision RSA compared with hemiarthroplasty or traditional unconstrained total shoulder arthroplasty.^{2,4,6,22} Complications have included higher infection rate, humeral fracture, scapular notching, acromial fractures, implant dislocation, and early catastrophic failure with glenosphere-glenoid dissociation.

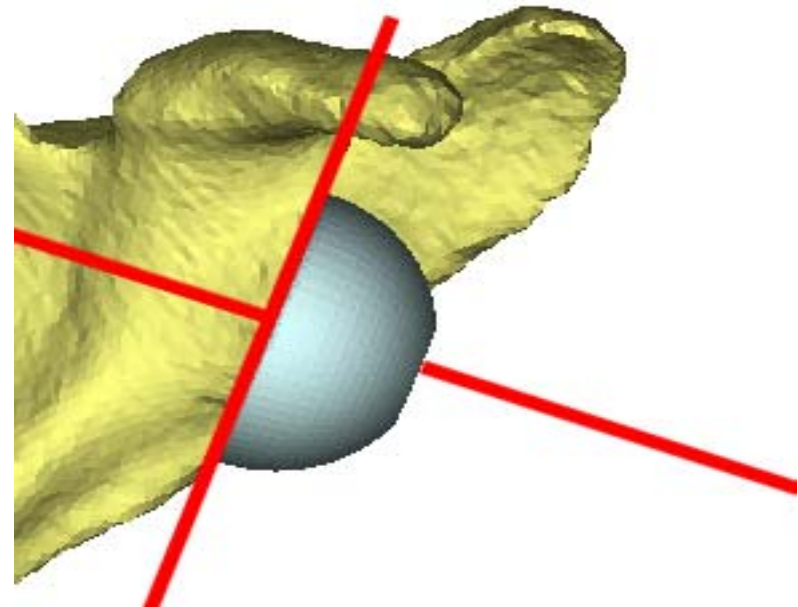
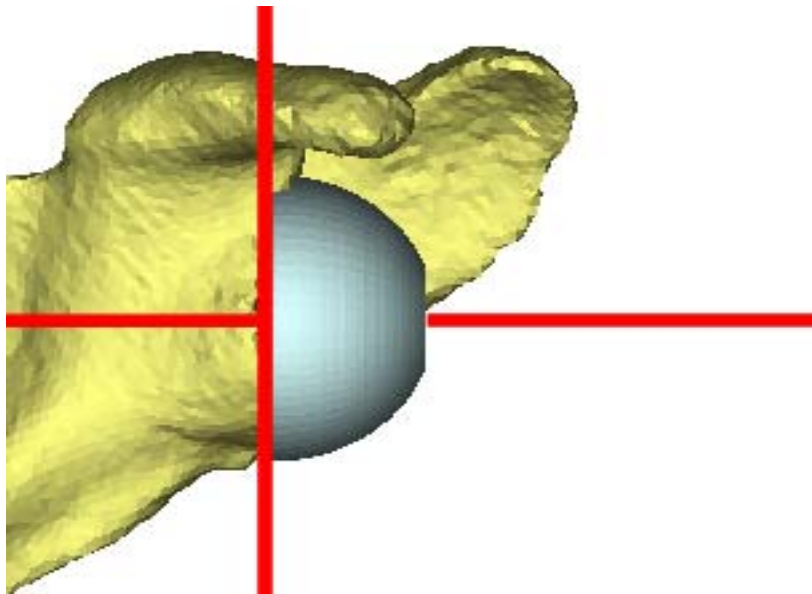
Although some newer baseplate designs may allow bone ingrowth and improved longevity of the glenosphere baseplate fixation, initial rigid fixation is substantially determined by solid screw purchase within the glenoid.^{1,16,17} Recent cadaveric studies have analyzed the effect of inferior glenoid placement of the glenosphere and concluded that this may help decrease scapular

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E-mail address: evan.flatow@mssm.edu (E.L. Flatow).



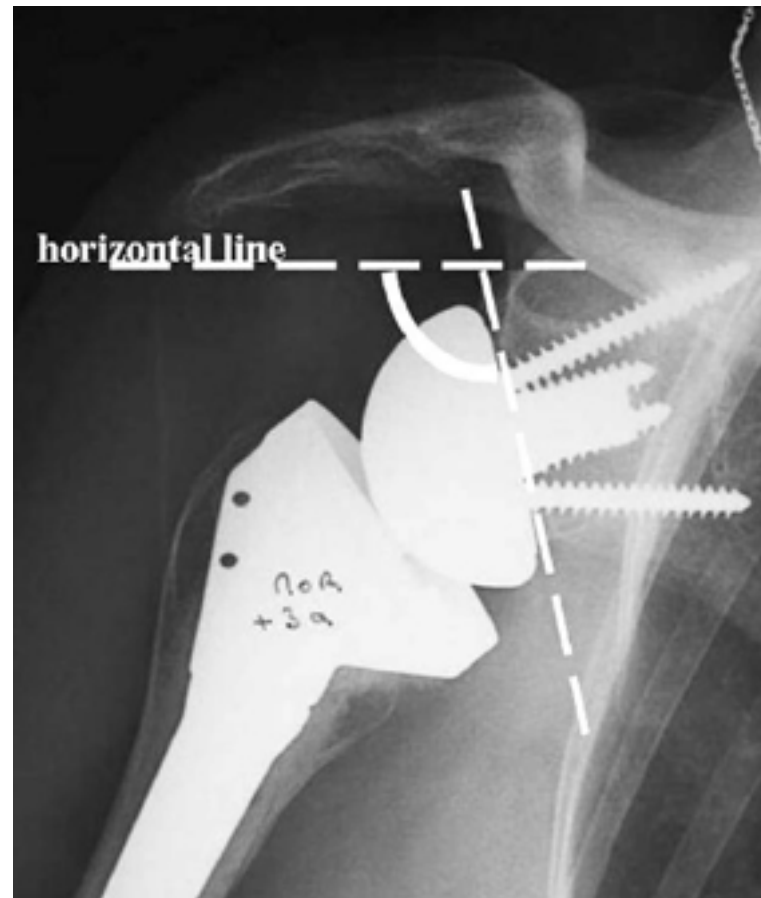
Come evitarlo?

☺ Angolare il M-B a 15°-20°



Come evitarlo?

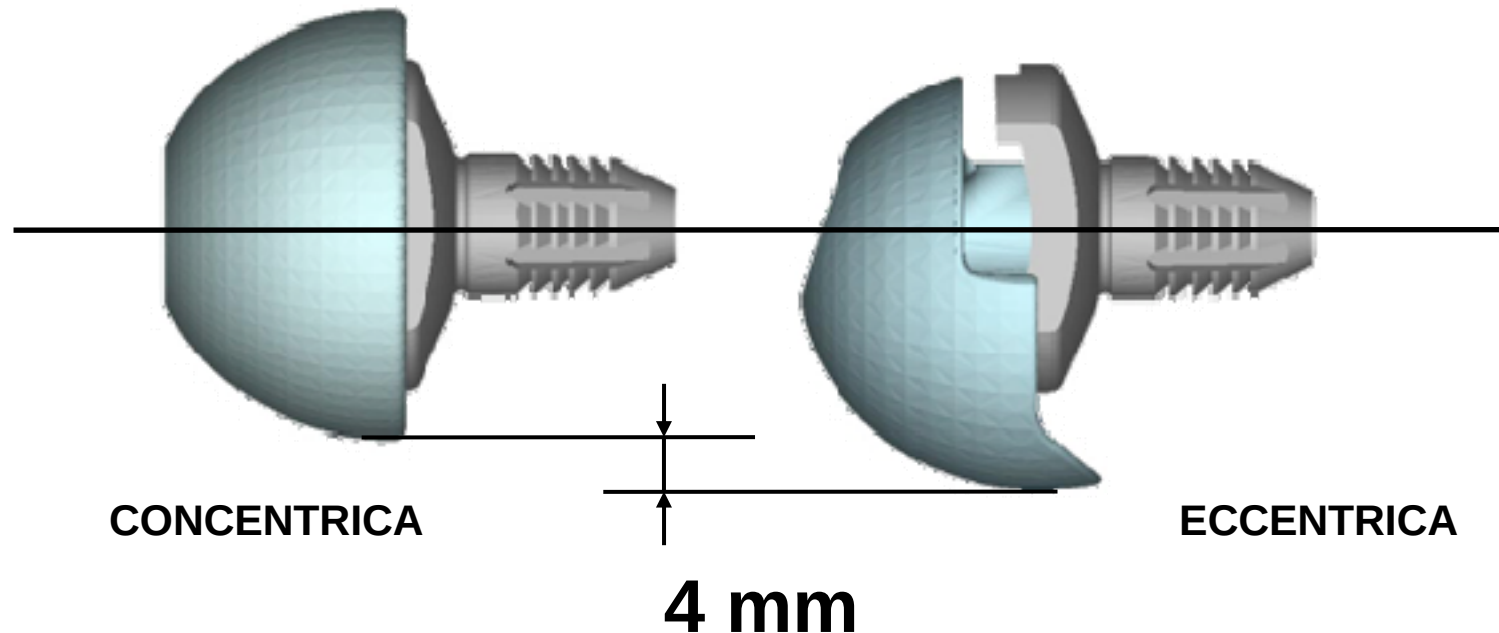
😊 **Angolare il M-B a 15°-20°**



Come evitarlo?

Glenosfera Eccentrica

- Il Metal-Back non viene traslato
- Il Centro di Rotazione è abbassato di 4 mm rispetto all'asse del Metal-Back



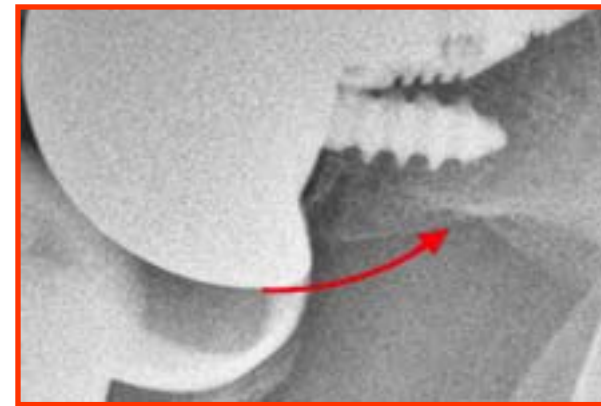
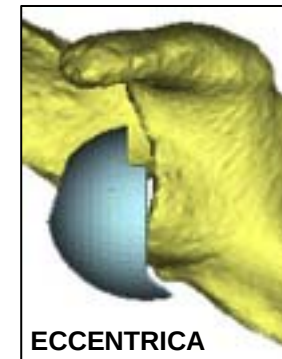
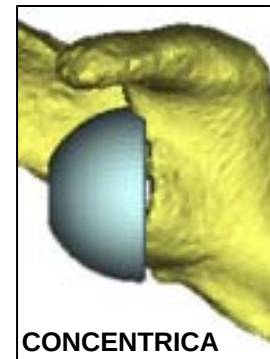
Come evitarlo?

- Viene incrementato il ROM in adduzione e si limita lo scapular notch

CONCENTRICA



ECCENTRICA

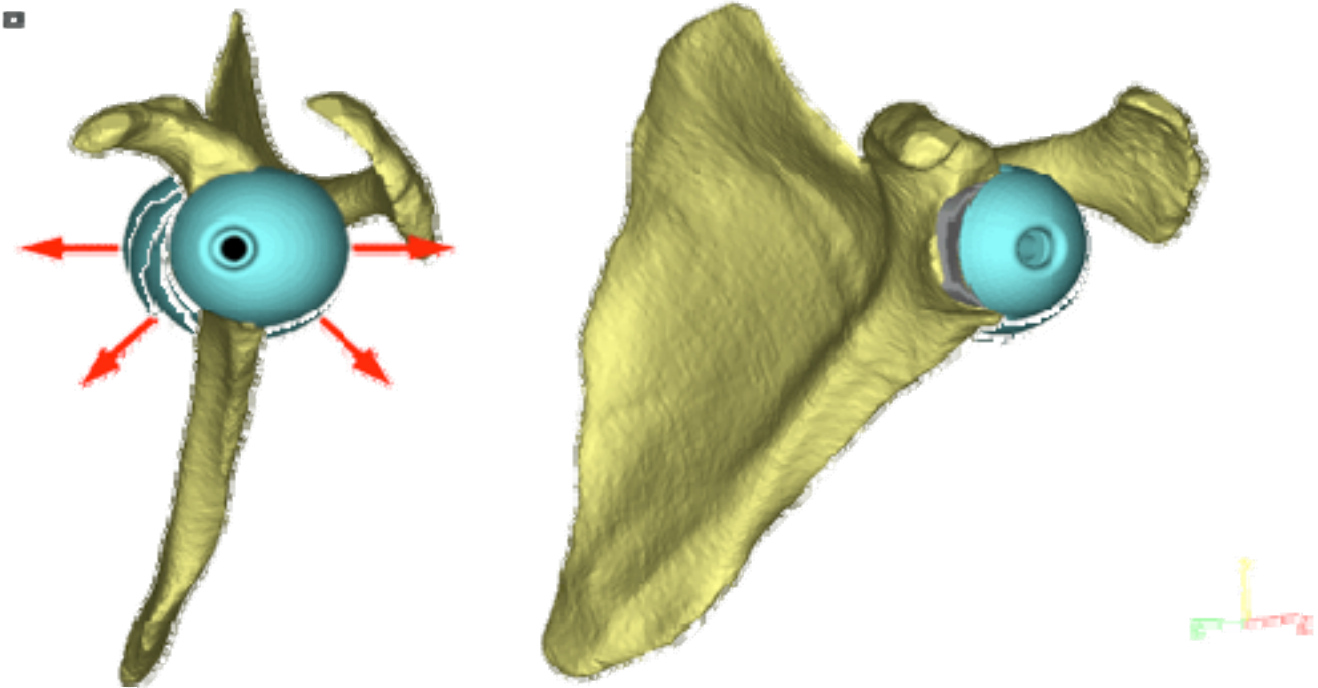


Come evitarlo?

La Glenosfera eccentrica può anche essere ruotata liberamente

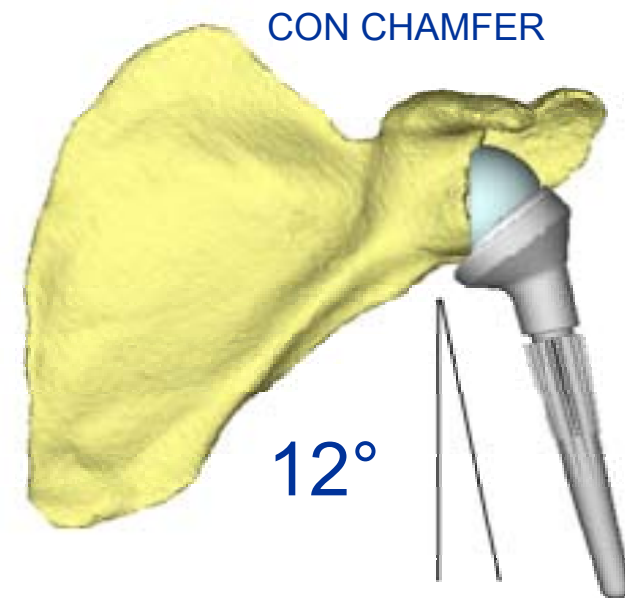
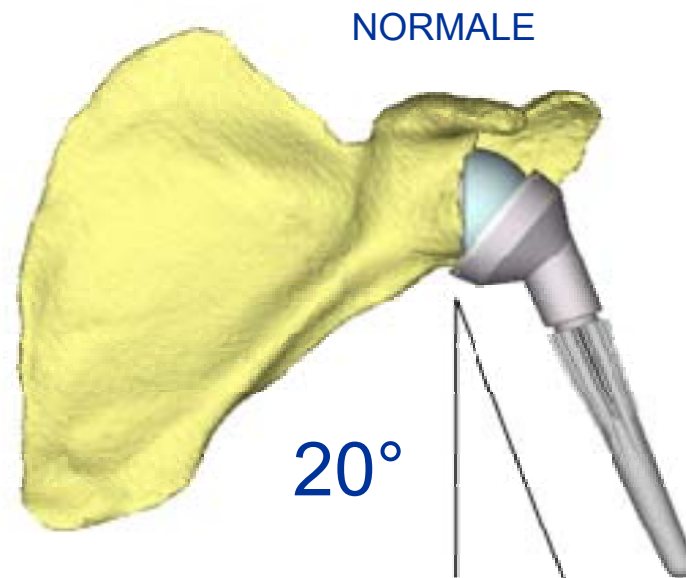
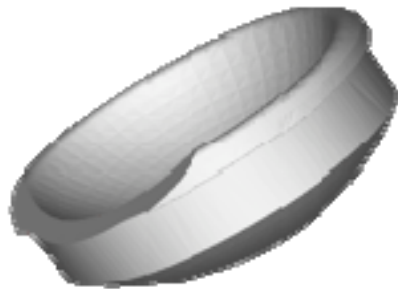
Correzione di:

- Anatomia anormale
- Errore di posizione del Metal-Back
- Instabilità



Come evitarlo?

Bordo dell'inserto tagliato (*chamfer*)

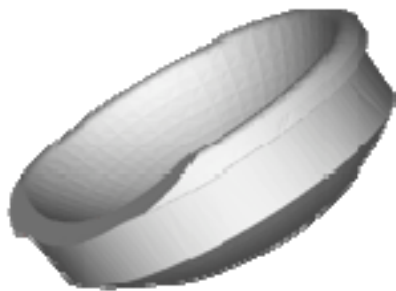


permette un incremento dell'adduzione
prima del contatto scapolare



Pericolo !

Bordo dell'inserto tagliato (*chamfer*)



Aumento della probabilità di instabilità della protesi!!!

Instabilità articolare

- Problema frequente (fino a 10%)
- Le RSP non sono vincolate!
- Più frequente nelle revisioni e in completa assenza di cuffia
- Avvengono di solito entro i primi giorni (max 2 mesi)



Instabilità articolare

La manovra più pericolosa è quella di alzarsi dalla poltrona facendo leva sull'omero



Instabilità articolare

Può essere legata a:

- **via chirurgica**
- errori di posizionamento della componente omerale o glenoidea
- mancanza di strutture osse e/o legamentose adeguate
- Lesioni nervose



Instabilità articolare

Può essere legata a:

- via chirurgica
- **errori di posizionamento della componente omerale o glenoidea**
- mancanza di strutture osse e/o legamentose adeguate
- Lesioni nervose



Objective evaluation of lengthening in reverse shoulder arthroplasty

Alexandre Lädermann, MD^a, Matthew D. Williams, MD^b, Barbara Melis, MD^c,
Pierre Hoffmeyer, MD^a, Gilles Walch, MD^{c,*}

Instabilità articolare

Può essere legata a:

- via chirurgica
- errori di posizionamento della componente omerale o glenoidea
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Instabilità articolare



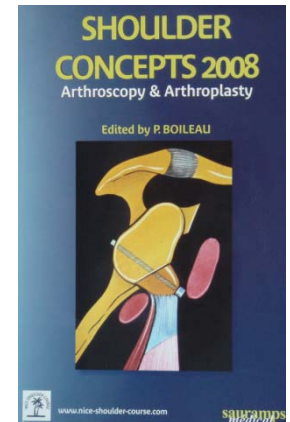
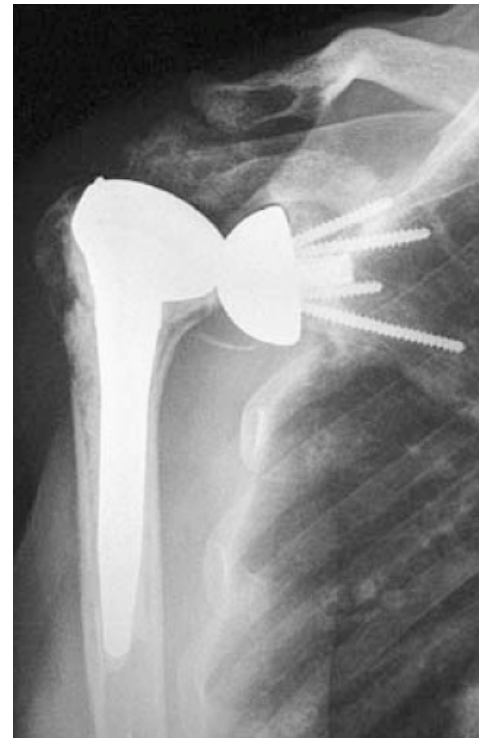
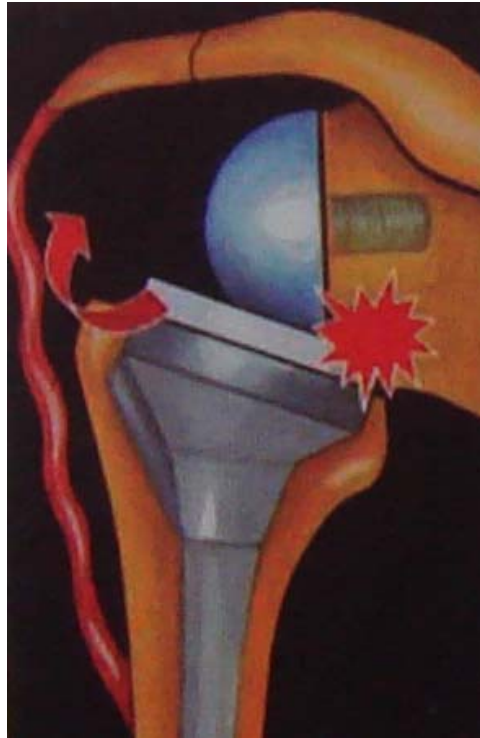
Bone Stock adeguato



Bone Stock insufficiente

Instabilità articolare

Eccessiva medializzazione del centro di rotazione



Deltoide non in tensione

+

Impingement inferiore

= instabilità

Instabilità articolare

Lesione del Sottoscapolare !!!

SUBSCAPULARIS MUSCLE FUNCTION AND STRUCTURE AFTER TOTAL SHOULDER REPLACEMENT WITH LESSER TUBEROSITY OSTEOTOMY AND REPAIR

BY CHRISTIAN GERBER, MD, EDWARD H. YIAN, MD, CHRISTIAN A.W. PFIRRMANN, MD,
MATTHIAS A. ZUMSTEIN, MD, AND CLÉMENT M.L. WERNER, MD

Investigation performed at Balgrist Hospital, Zurich, Switzerland

Rupture of the subscapularis tendon after shoulder arthroplasty: Diagnosis, treatment, and outcome

Bruce S. Miller, MD,^a Thomas A. Joseph, MD,^b Thomas J. Noonan, MD,^c Marilee P. Horan, BS,^c and
Richard J. Hawkins, MD, FRCS(C),^c Ann Arbor, MI, Canfield, OH, and Vail, CO

Instabilità articolare

Table I Fatty infiltration of the rotator cuff musculature

Fatty infiltration grade	Rotator cuff muscle		
	Supraspinatus	Infraspinatus	Subscapularis
0, No. (%)	11 (7.9)	11 (7.9)	26 (18.8)
1, No. (%)	13 (9.4)	12 (8.8)	32 (23.2)
2, No. (%)	15 (10.9)	15 (10.9)	26 (18.8)
3, No. (%)	13 (9.4)	13 (9.4)	16 (11.6)
4, No. (%)	86 (62.4)	87 (63.0)	38 (27.6)

“... an **insufficient subscapularis** at the time of reverse arthroplasty significantly increases the risk of postoperative dislocation when the procedure is performed through a deltopectoral approach ...”

J Shoulder Elbow Surg (2009) ■ 1-9



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Subscapularis insufficiency and the risk of shoulder dislocation after reverse shoulder arthroplasty

T. Bradley Edwards, MD*, Matthew D. Williams, MD, Joanne E. Labriola, MD, Hussein A. Elkousy, MD, Gary M. Gartsman, MD, Daniel P. O'Connor, PhD

Fondren Orthopedic Group, Houston, TX

Hypothesis: Dislocation is the most common serious complication after reverse shoulder arthroplasty. One theorized cause is subscapularis insufficiency because the tendon cannot be repaired at the time of surgery. There are no documented risk assessments of reverse total shoulder arthroplasty dislocation related to this cause. The study objective was to quantify the risk of postoperative dislocation after reverse total shoulder arthroplasty in patients with a subscapularis tendon that was irreparable at the time of surgery.

Methods: A prospective evaluation was done of 138 consecutive reverse arthroplasties performed through a deltopectoral approach by a single surgeon (average follow-up, 36 months).

Results: The subscapularis was repairable in 62 patients and irreparable in 76 at the conclusion of the procedure. Seven postoperative dislocations occurred; all dislocations were in patients whose subscapularis was irreparable ($P < .012$). Dislocations were more likely in patients with complex diagnoses, including proximal humeral nonunion, fixed glenohumeral dislocation, and failed prior arthroplasty.

Conclusions: This report documents that an irreparable subscapularis tendon at the time of reverse total shoulder arthroplasty using a deltopectoral approach results in a statistically significant risk for postoperative dislocation.

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Keywords: Subscapularis; irreparable; reverse; shoulder; arthroplasty; complication; instability; dislocation

Paul Grammont⁸ first reported his modern design for a reverse shoulder prosthesis in 1987. The reverse shoulder was initially designed for end-stage rotator cuff arthropathy and pseudoparalysis with instability to elevate the arm. The development and improvement of Grammont's original design has led to the reverse shoulder prosthesis becoming an important tool in the treatment of difficult shoulder pathologies.^{3,11-13} The exciting treatment possibilities and results offered by the reverse prosthesis has led to an explosion of its use. However, the excitement must be tempered by the higher complication rate of reverse

shoulder arthroplasty compared with unconstrained shoulder arthroplasty. Studies of reverse total shoulder arthroplasty (TSA) that included more than 30 patients have reported overall complication rates of 10% to 47%, with dislocation rates of 0% to 9%.^{13,14,16-17} In these studies, dislocations accounted for up to 44% of all complications.

Causes of reverse TSA dislocation are often discussed and include the number of prior procedures, surgical approach, bone deficiency, subscapularis insufficiency, mechanical factors, and trauma. The literature contains no risk assessments of reverse TSA dislocation based on known possible causes. Many patients requiring reverse TSA do not have a sufficient subscapularis tendon to repair because of a chronic tear with retraction and fatty

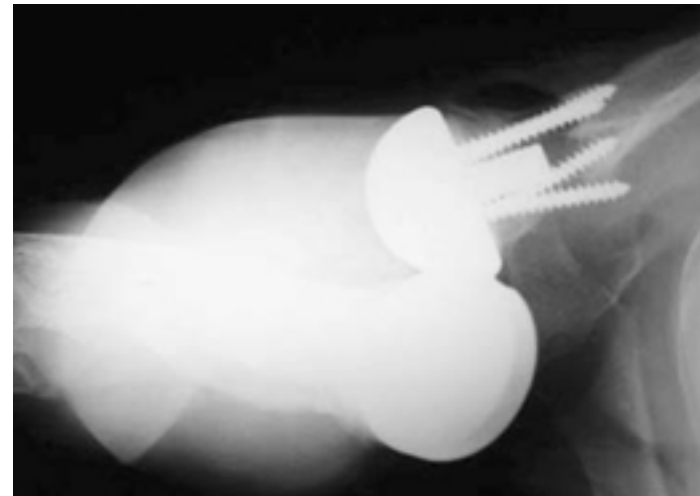
*Reprint requests: Dr T. Bradley Edwards, 7400 S Main St, Houston, TX 77054-4300.
E-mail address: tbedwards@fondren.com (T.B. Edwards).

Instabilità articolare

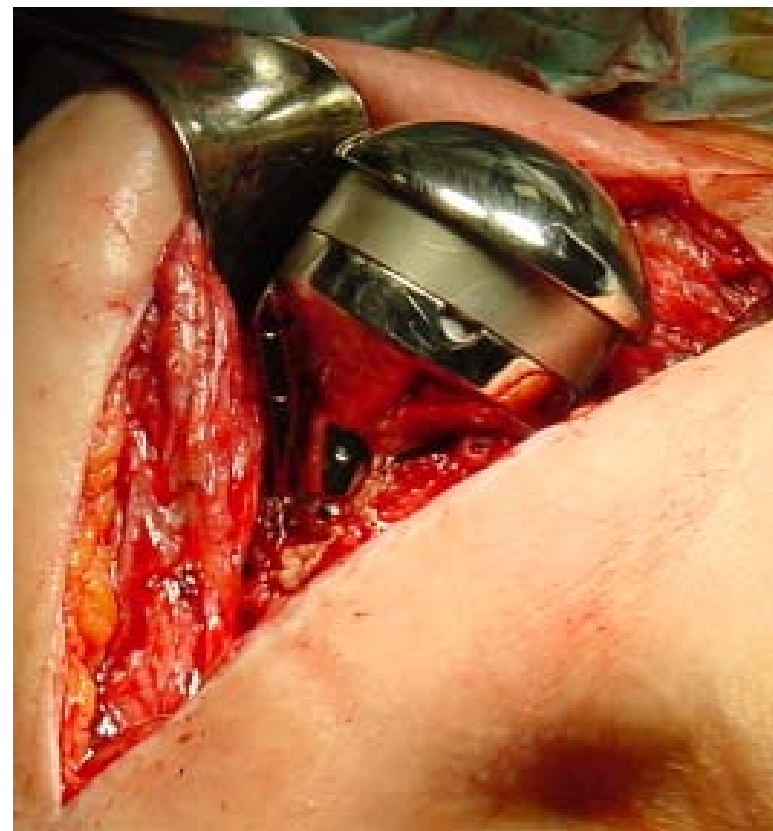
Clinica



Rx



Cosa fare ?



La protesi inversa come protesi di revisione negli insuccessi di emiartroplastica di spalla

The inverse prosthesis as a revision prosthesis in failures of shoulder hemiarthroplasty

P. Paladini, A. Collu*, F. Campl, G. Porcellini

Unità operativa di Chirurgia Ortopedica di Spalla e Gomito - Ospedale "D. Cervesi", Cattolica (RN)

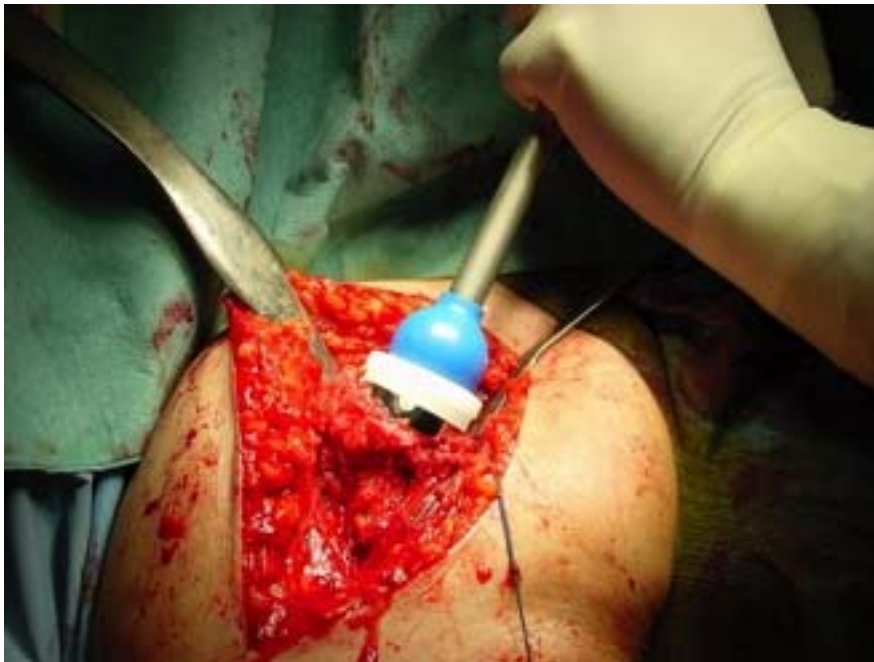
*Scuola di Specializzazione in Ortopedia e Traumatologia - Università degli Studi di Cagliari

Cosa fare ?

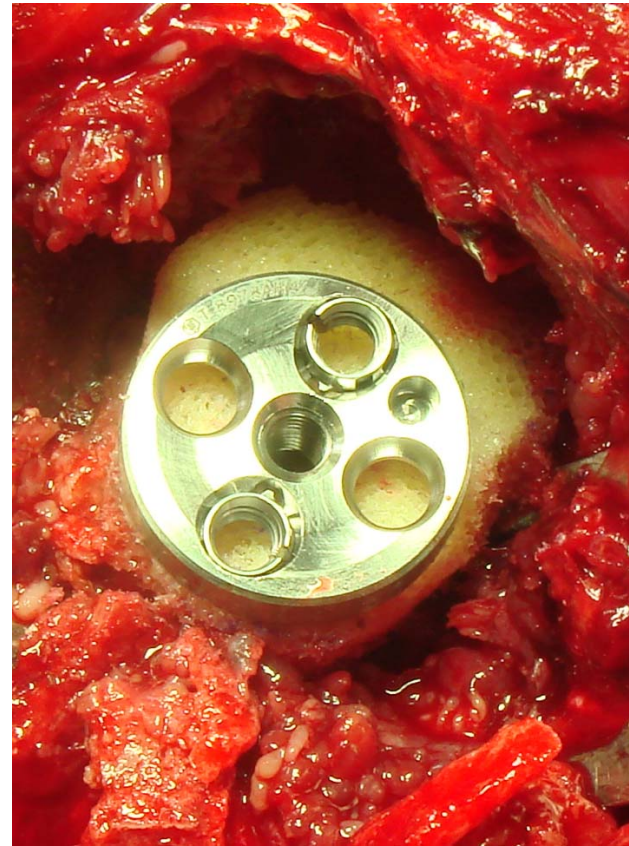
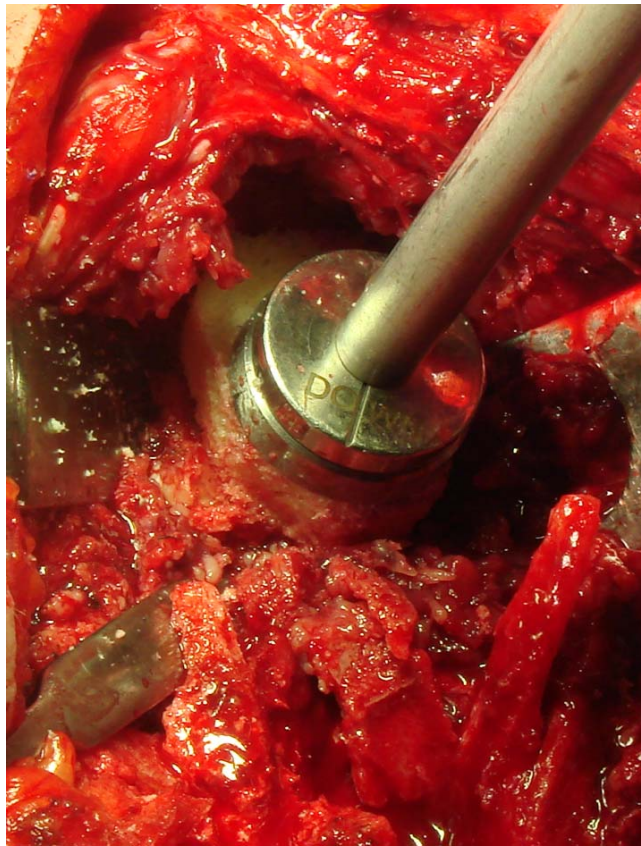
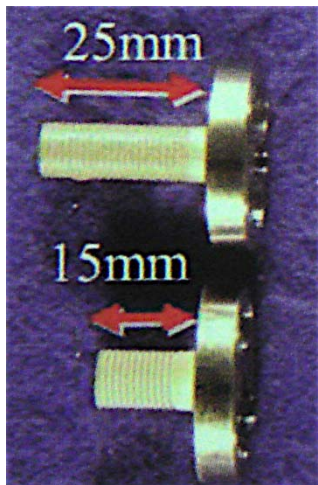
Sutura del sottoscapolare e del piccolo rotondo

Protesi inversa + trasposizione latissimus dorsi

Protesi inversa + trasposizione gran pettorale



Cosa fare ?



Fittone più lungo che eviti l'eccessiva medializzazione della metaglena

Conclusioni

The Reverse Shoulder Prosthesis for Glenohumeral Arthritis Associated with Severe Rotator Cuff Deficiency

A Minimum Two-Year Follow-up Study of Sixty Patients
Surgical Technique

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ABSTRACT

BACKGROUND

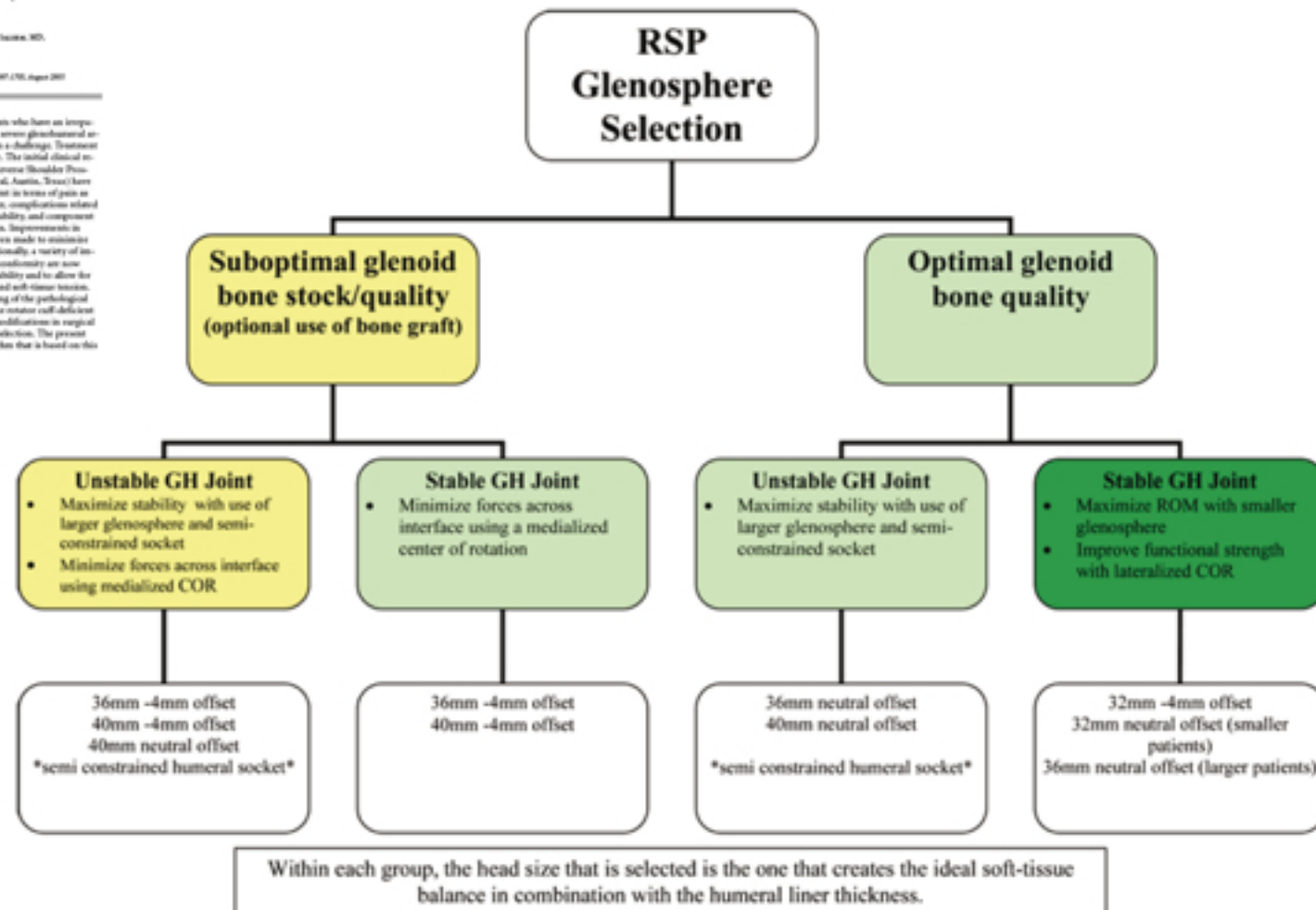
Patients who have pain and dysfunction from glenohumeral arthritis associated with severe rotator cuff deficiency have few treatment options. The goal of this study was to retrospectively evaluate the outcomes in terms of arthroplasty with use of the Reverse Shoulder Prosthesis in the management of this problem.

METHODS

We report the results for sixty patients (only shoulders) who were followed for a minimum of two years. Thirty-five patients had no previous shoulder surgery, whereas twenty-five had had either an open or arthroscopic rotator cuff repair. One patient had a subscapularis reconstruction, and one had had a biceps tendon repair. All patients were assessed preoperatively and postoperatively with the American Shoulder and Elbow Surgeons

INTRODUCTION

The management of patients who have an irreparable rotator cuff tear and severe glenohumeral arthritis historically has been a challenge. Treatment options continue to evolve. The initial clinical results associated with the Reverse Shoulder Prosthesis (RSP; Inceus Medical, Austin, Texas) have shown reliable improvement in terms of pain as well as function.^{1,2} However, complications related to mechanical failure, instability and component dissociation have been noted. Improvements in prosthetic fixation have been made to minimize mechanical failures. Additionally, a variety of implant sizes with increased conformity are now available to minimize instability and to allow for variations in patient size and soft tissue tension. An improved understanding of the pathological changes associated with the rotator cuff-deficient shoulder has resulted in modifications in surgical technique and prosthetic selection. The present report describes an algorithm that is based on this understanding.



Conclusioni

- Indicazione
- Conoscenza della biomeccanica
- Tecnica chirurgica scrupolosa
- Design e materiali

