

# Systematic Review of Reverse Total Shoulder Arthroplasty (RtSA), Indication and Complication

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**Abstract:** The original concept of the modern reverse total shoulder arthroplasty (RtSA) for eccentric shoulder osteoarthritis (OA) was very first explained by Grammont et al. in 1993. The literature search was based on the PubMed database from 1985 to June 2012. The authors are not aware of any relevant publication related to RSA before 1985, so the search was limited to this period. The keywords and search strategy employed in this study included the following: (Reverse OR inverse) AND shoulder AND (arthroplasty OR replacement OR prosthesis), limited to human studies published in the above-mentioned period. Complementary databases were used to avoid missing an important article for this study. Most of the studies did not reveal the results depending upon the signs for surgery, so this specification needed to be thought about independently to prevent a considerable reduction in the variety of research studies consisted of in the contrasts of results. Therefore, just the kind of prosthesis and kind of method might be examined completely. Second, as nearly all consisted of research studies were case series, the contrast of results depending upon the kind of prosthesis, method, and an indicator was indirect in nature with a higher possible impact of unchecked variables. Third, the impact of a number of aspects possibly affecting the results might not be evaluated due to the fact that of minimal info, heterogeneity of research studies, and small number of research studies consisted of for some contrasts (which would reduce much more the readily available information if more subgroups were done).

**Keywords:** Reverse OR inverse, arthroplasty OR replacement OR prosthesis, Complementary databases.

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## 1. INTRODUCTION

The original concept of the modern reverse total shoulder arthroplasty (RtSA) for eccentric shoulder osteoarthritis (OA) was very first explained by Grammont et al. in 1993 <sup>(1)</sup>. Over the previous years, this prosthetic design has actually discovered unique signs for lots of other pathologies, such as intricate proximal humeral fractures and their sequelae, permanent rotator cuff tear (RCT) with or without pseudoparalysis, and hemi-implant or overall implant failures <sup>(2)</sup>. Reverse shoulder arthroplasty (RSA) is a typical surgery for degenerative joint disease with lacking rotator cuff <sup>(2,3)</sup>. Theoretical benefits of RSA are increased lever arm of the triangular muscle through a medialized center of rotation of the prosthesis (increasing triangular performance), increased prosthetic stabilization through humeral lengthening (increasing triangular stress), and reduced mechanical torque at the glenoid element (reducing glenoid loosening) <sup>(4,5)</sup>. especially for treatment of rotator cuff tear arthropathy and A conclusive set of indicators has actually been explained for optimum advantage of RtSA: patients with irreversible rotator cuff tear with irrecoverable pseudoparalysis, exceptional or anterior humeral head migration and pain, and undamaged triangular function or innervation due to the fact that it is the practical motor system of the RtSA (5-10), enormous permanent rotator cuff tears without osteoarthritis and stopped working hemiarthroplasty with permanent rotator cuff tearing <sup>(11,12)</sup>. This medically effective principle, nevertheless, suggests modifications of joint physiology and biomechanics <sup>(6,13)</sup>. Recent research studies revealed a high rate of issues, varying from 14 to 75% (14), generally reported throughout the knowing stage, but also encountered by skilled surgeons because of objective technical difficulties and limitations of the prosthesis design <sup>(14)</sup>.

## 2. METHOD AND MATERIALS

### STUDY DESIGN:

Systematic review study was conducted following the PRISMA statement for systematic review and meta-analysis<sup>(15)</sup>. All human studies reporting clinical and/or functional outcomes in patients treated with primary or revision RSA were assessed for eligibility.

### SEARCH STRATEGY:

The literature search was based on the PubMed database from 1985 to June 2012. The authors are not aware of any relevant publication related to RSA before 1985, so the search was limited to this period. The keywords and search strategy employed in this study included the following: (Reverse OR inverse) AND shoulder AND (arthroplasty OR replacement OR prosthesis), limited to human studies published in the above-mentioned period. Complementary databases were used to avoid missing an important article for this study. Thus, CINAHL, EBSCO-SPORTDiscus, and the Cochrane Central Register of Controlled Trials were also used to search for relevant publications in the same period. A literature search was performed by one of the authors. Articles of potential interest were reviewed in detail (full text) by different authors and a decision was made regarding inclusion or exclusion. Clinical and functional outcomes were extracted from all included studies different authors, which was then verified by another author, in case of disagreement between all authors with regard to study inclusion or data extraction.

## 3. RESULTS AND DISCUSSION

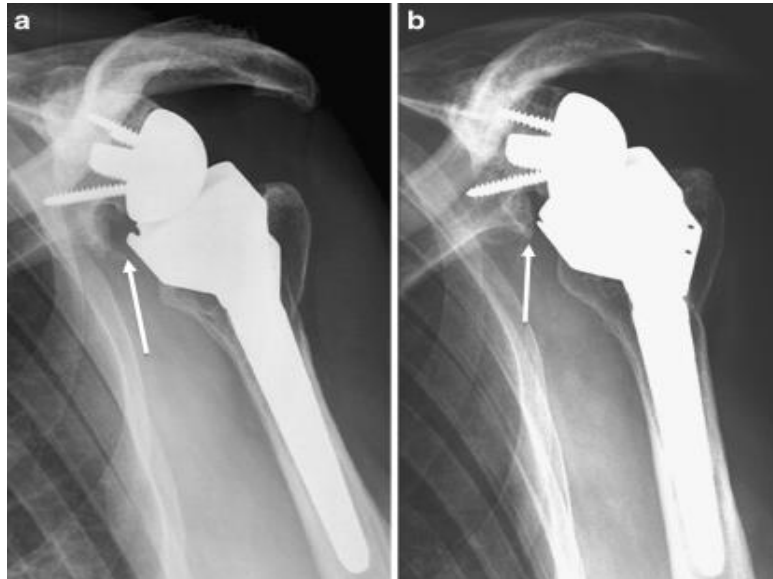
### *Indication of RSA:*

One of the included studies was conducted by Khan *et al.*<sup>(16)</sup> performed a comprehensive, systematic review intended to examine the results of RSA depending for cuff tear arthropathy, enormous cuff tear, and rheumatoid arthritis<sup>(16)</sup>. The authors just consisted of Delta II prostheses and the evaluation consisted of research studies up to 2010. Today examination discovered lots of recommendations in the last 2 years and in addition, various kinds of prostheses, more signs, and a greater variety of research studies were evaluated. Based upon today research study and on the existing literature, RSA is an outstanding surgical option with excellent enhancements in scientific results for cuff tear arthropathy,<sup>(4,8,16-23)</sup> huge cuff tear,<sup>(16,18)</sup> 42 stopped working rotator cuff repair work,<sup>(20,22,24)</sup> rheumatoid arthritis,<sup>(24,25)</sup> fracture sequelae,<sup>(17,26,27)</sup> modification of structural prosthesis,<sup>(4,8,17, 20,22)</sup> and modification of reverse prosthesis<sup>(28)</sup>. Other indicators now consist of the treatment of complicated fractures of the proximal humerus in the senior,<sup>(29)</sup> along with osteoarthritis with posterior subluxation and a biconcave glenoid<sup>(4)</sup>. Considering that RSA is typically utilized to restore intricate conditions, not remarkably the reported problem rate is reasonably high<sup>(30)</sup>.

### *Complications of RtSA:*

#### *1. Instability and Scapular notching:*

The most frequently reported by included studies<sup>(6,16,31-34)</sup> in this review ( “complication” of RTSA is notching of the bone of the inferior and posterior scapular neck (**Figure. 1**)<sup>(6,16,31-34)</sup>. Notching determines the radiographic look of resorption or wear of the lateral pillar of the scapula right away median and gradually likewise exceptional to the inferior element of the glenoid baseplate. Its intensity has actually been stratified by the Nérot category<sup>(35)</sup> beginning without any noticeable notching on real anteroposterior radiographs (phase 0) to a resorption which surpasses the main peg of the glenoid part (phase 4). Scapular notching is plainly a physiological issue with partial damage of the inferior element of the glenoid, its scientific significance is unsure; in some research studies it was plainly associated with an inferior medical result<sup>(36)</sup> and in others it was thought about to be medically unimportant<sup>(37)</sup>. In an impressive case research study, Nyffeler *et al.*<sup>(38)</sup> might record that the remarkable baseplate stayed really sturdily bound to the underlying bone despite the fact that the inferior half of the glenoid had actually been resorbed<sup>(38)</sup>. This observation tallies with that modification for notching or for loosening up secondary to notching is basically unreported.



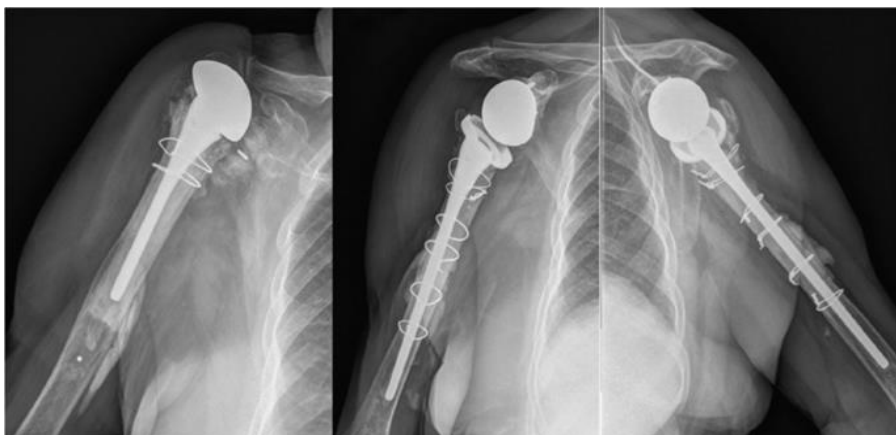
**Figure. 1: Radiological anteroposterior view of scapular notching grade 2 (according to Nérot classification) at three (a) and eight years (b) after reverse total shoulder arthroplasty (RTSA) (Delta III) <sup>(38)</sup>**

Numerous preoperative findings have actually been connected with advancement of notching; rotator cuff tear arthropathy, fatty seepage of the infraspinatus, narrowed acromiohumeral range and a par excellence oriented glenoid are danger elements for establishing notching <sup>(11)</sup>. Personnel specifications connected with notching are the anterosuperior technique, high position of the baseplate <sup>(11,38)</sup> and insufficient prosthesis-scapular neck angle <sup>(36)</sup>. Inferior positioning of the glenoid baseplate is most likely not just essential to acquire great series of motion however likewise the most essential element to avoid scapular notching <sup>(38)</sup>.

Forecast of the probability of notching with a level of sensitivity of 91% and uniqueness of 88% can be attained using the notching index, computed from the height of implantation of the glenosphere and the postoperative prosthesis-scapular neck angle <sup>(36)</sup>.

## 2) Intra-operative fractures complication:

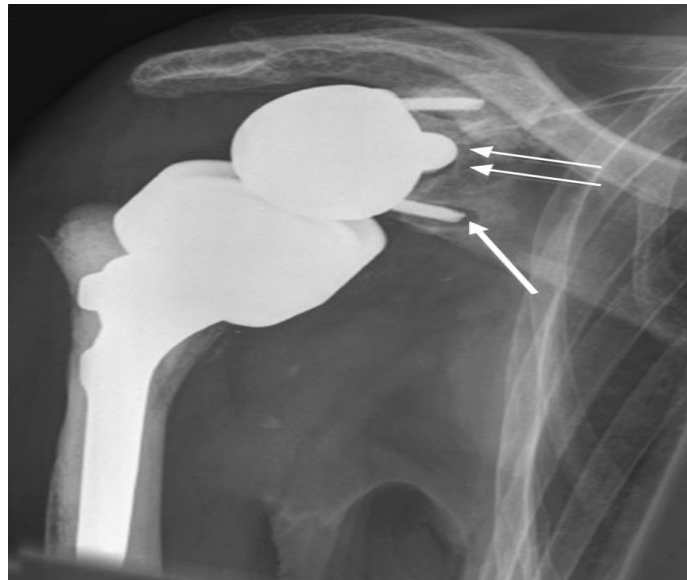
Intra-operative fractures (**Figure. 2**) <sup>(38)</sup> can take place on the glenoid or humeral side. Wierks et al <sup>(38)</sup> reported 6 glenoid fractures and 2 humeral fractures in a series of 20 patients. Valenti et al <sup>(35)</sup> reported 3 glenoid fractures in 39 patients, and Boileau reported one glenoid fracture in a series of 45 patients <sup>(35)</sup>. Suggestions to reduce the rate of glenoid fractures consist of beginning power reaming prior to putting the reamer on the face of the glenoid, and avoidance of over-reaming.



**Figure. 2: This figure shows the case of a patient with an intra-operative fracture. An anteroposterior radiograph of the right shoulder of a female patient operated for revision arthroplasty of a cemented hemiarthroplasty for post-traumatic sequelae of a proximal humerus fracture is shown (left column). Revision arthroplasty is at greater risk of suffering intra-operative fractures when compared to primary arthroplasty. When the fracture is proximal to the tip of the stem, most may be treated successfully by circumferential cerclage. In this case a long stem was used in addition to bypass a cortical window needed for cement extraction of the previous implant (middle and right columns).**

### 3) Complications of the glenoid component:

Four of our included studies <sup>(3,40,41,42)</sup> Reported glenoid problems consist of glenoid loosening (**Figure. 3**), glenoid part dissociation, loosening and scapular neck fracture. Glenoid loosening is the most regular glenoid part issue in RTSA however it is clearly less regular than glenoid part loosening in standard TSA <sup>(40,41)</sup>. Loosening has actually been reported as the most typical requirement for modification <sup>(42)</sup>. Its frequency has actually been recorded to be 4.1% after 2 years, leaving out the prostheses which had actually been eliminated prior to a two-year follow-up <sup>(3)</sup>.



**Figure.3: Glenoid component loosening six months after reverse total shoulder arthroplasty (RTSA) for irreparable rotator cuff arthropathy and osteoarthritis. Radiolucency is seen particularly around the inferior screw (arrow) and around the glenoidal implant <sup>(3)</sup>**

The first study <sup>(3)</sup> reported that the risk factors for glenoid loosening are female gender, age younger than 70 years and a superolateral approach. Superior tilt, often associated with the superolateral approach, appears as a risk factor for glenoid loosening in both genders <sup>(3)</sup>.

### 3) Infection as common complication of RtSA:

The included studies <sup>(43,44,45,46)</sup> in this manner reported rate of infection for RtSA is higher than for structural shoulder arthroplasty. The factors are not constantly clear. Aspects that might describe the greater infection rate consist of increased implant surface area, a bigger dead area, patient aspects and the intricacy of a few of the indicators <sup>(43)</sup>, the reported occurrence in the literature differs from 1% to 15%. In a meta-analysis, Zumstein et al <sup>(44)</sup> reported a mean infection rate of 3.8% in a methodical evaluation consisting of primary and modification RSA, with a greater rate in modification surgery <sup>(44)</sup>. For non-reverse arthroplasty, lower rates of infection have actually been reported. In a single organization research study, the rates were 0.7% (18/2512) for primary and 3.15% (7/22) for modification structural arthroplasty. Equivalent rates have actually been reported in an incorporated health care system (7.5%-- 24/3014 in primary; 2.4%-- 21/868 in modification physiological arthroplasty) <sup>(45,46)</sup>.

## 4. CONCLUSION

Most of the studies did not reveal the results depending upon the signs for surgery, so this specification needed to be thought about independently to prevent a considerable reduction in the variety of research studies consisted of in the contrasts of results. Therefore, just the kind of prosthesis and kind of method might be examined completely. Second, as nearly all consisted of research studies were case series, the contrast of results depending upon the kind of prosthesis, method, and an indicator was indirect in nature with a higher possible impact of unchecked variables. Third, the impact of a number of aspects possibly affecting the results might not be evaluated due to the fact that of minimal info, heterogeneity of research studies, and small number of research studies consisted of for some contrasts (which would reduce much more the readily available information if more subgroups were done). It needs to be discussed that the ASES rating in mediatised prosthesis was just reported by one research study, Complications after reverse shoulder arthroplasty,

continue to be greater in primary and modification shoulder surgery when compared to overall shoulder arthroplasty. Regardless of continued experience and much better understanding of the fundamental principles of RSA, issues still take place, even in the most skilled hands. The rate of problems is affected by numerous aspects. As the idea and style of the reverse shoulder is developing, the rate and kind of problem might alter in time.

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