



# Reverse shoulder arthroplasty with a cementless short metaphyseal humeral implant without a stem: clinical and radiologic outcomes in prospective 2- to 7-year follow-up study



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**Background:** Reverse shoulder prostheses are increasingly used in recent years for treatment of glenohumeral arthropathy with deficient rotator cuff. Bone preservation is becoming a major goal in shoulder replacement surgery. Metaphyseal humeral components without a stem were developed to minimize bone resection and preserve bone. This study evaluated the clinical and radiologic outcomes at 2 to 7 years using a novel short metaphyseal reverse total shoulder arthroplasty (rTSA) prosthesis without a diaphyseal stem.

**Methods:** Between 2005 and 2010, 102 consecutive patients underwent rTSA with this implant, and 98 (20 men, 78 women) were available for follow-up. Mean age was 74.4 years (range, 38–93 years). Indications were cuff tear arthropathy, 65; fracture sequelae, 12; rheumatoid arthritis, 13; failed rotator cuff repair, 3; cuff deficiency with loosening of anatomic prosthesis, 3; and acute trauma, 2; with 17 of these as revisions.

**Results:** Patients' satisfaction (Subjective Shoulder Value) improved from 8 of 100 to 85 of 100. The Constant score improved from 14 to 59 (age- and sex-adjusted, 86;  $P < .0001$ ). Range of motion improved from 47° to 129° in elevation, 10° to 51° in external rotation, and 21° to 65° in internal rotation. Radiographic analysis showed no lucencies, subsidence, or stress shielding around the humeral or glenoid components. Glenoid notching was found in 21 patients (18 grade 1–2; 3 grade 3).

**Conclusions:** The short metaphyseal rTSA design without a diaphyseal stem shows encouraging short- to midterm results, with excellent pain relief and shoulder function, restoration of good active range of motion, and high patient satisfaction scores. The design of this implant seems to result in improved rotational movements, low incidence of glenoid notching, and no implant loosening, subsidence, or stress shielding.

**Level of evidence:** Level IV; Case Series; Treatment Study

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**Keywords:** Shoulder; arthroplasty; reverse TSA; cementless; replacement; metaphyseal; bone graft impaction; glenoid notching; rotation

The Royal Berkshire Hospital Audit and Review Board approved the study (Study No. N3114).

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Reverse shoulder prostheses are increasingly used in recent years for the treatment of glenohumeral arthropathy with a deficient rotator cuff, including rotator cuff arthropathy, rheumatoid arthritis, proximal humeral fractures sequelae, irreparable rotator cuff tears, and failed shoulder replacement.<sup>9,18,39,41,47</sup> Good mid- and long-term results with restoration of active elevation have been reported.<sup>4,17,21,22,39,49,50</sup> However, early studies showed relatively high rates of complications (range, 24%-50%),<sup>19,23</sup> and many of these required further surgery.<sup>4,49,50,54,57,61</sup>

Preservation of bone has therefore become a major goal. Metaphyseal cementless implants without a diaphyseal stem have been developed to preserve bone and resect only a minimal amount of bone.<sup>2,3,29,53</sup> Analyzing the results of new designs with close surveillance and follow-up is crucial.

Information about the midterm clinical and radiologic outcomes associated with uncemented metaphyseal reverse total shoulder arthroplasty (rTSA) is currently limited.<sup>2,3,29,53</sup> The aim of this prospective study was to report the 2- to 7-year clinical and radiologic results with rTSA with a short metaphyseal humeral design, without a diaphyseal stem, discuss the design rationale, and determine the safety and complication rate of this design.

## Materials and methods

### Patients

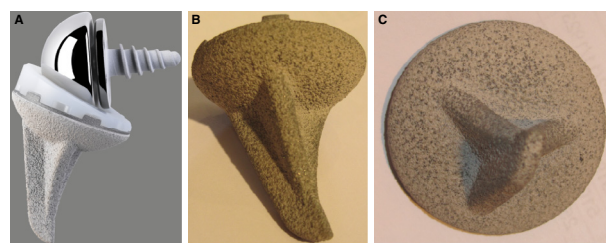
This prospective study included 102 consecutive patients who underwent cementless press-fit rTSA with a novel, short metaphyseal humeral design, without a diaphyseal stem (Verso; Innovative Design Orthopaedics, London, UK; formerly, Biomet, Swindon, UK), for the treatment of glenohumeral arthropathy with deficient rotator cuff by a single surgeon (O.L.) in our institution between 2005 and 2010.

The indications for surgery were disabling pain and poor function in patients in whom nonoperative treatment had failed. We always try conservative treatment first with the deltoid rehabilitation regimen. All patients with indication for rTSA were included. All patients gave informed consent.

Exclusion criteria included patients with any evidence of infection or neurologic disease and patients who needed a stem as a scaffold: acute fractures, surgical neck nonunions, and revision of stemmed implant with deficient metaphyseal bone.

Of the 102 patients, 98 (20 men, 78 women) were available for follow-up analysis. Two patients did not return for later follow-up appointments due to unrelated medical and social reasons (but were contacted by telephone), and 2 patients died of unrelated causes within a year after surgery. The average follow-up was 50 months (range, 24-82 months).

The mean age at surgery was 74.4 years (range, 38-93 years). Sixty-five patients were operated on for cuff tear arthropathy (including 11 revisions of resurfacing with cuff deficiency), 12 for fracture sequelae (including malunion and tuberosity malunion, deformity, and 1 failed hemiarthroplasty for fracture), 13 for rheumatoid arthritis (including 2 revisions of resurfacing with cuff deficiency), 3 for failed rotator cuff repair, 3 for cuff deficiency with glenoid loosening of an anatomic prosthesis, and 2 for acute trauma (dislocation with massive rotator cuff tear and preceding arthritis). Five



**Figure 1** (A) The Verso (Innovative Design Orthopaedics, London, UK) stemless reverse metaphyseal total shoulder arthroplasty prosthesis. (B and C) The stemless humeral component consists of 3 metaphyseal tapered thin fins.

patients underwent bilateral (staged) rTSA. Seventeen patients were operated on as revision arthroplasty: 16 were revisions of resurfacing prostheses, and 1 was a revision of a stemmed prosthesis to stemless rTSA. All of these revisions were due to rotator cuff tears and cuff deficiency.

During the same period, the study excluded 8 patients who were treated with the stemmed Verso press-fit cementless rTSA due to acute fractures, surgical neck nonunions, and revision of stemmed implant with deficient metaphyseal bone.

### Description of the implant

The humeral component is a short metaphyseal implant with 3 tapered thin fins that give immediate metaphyseal press-fit fixation when impacted into the cancellous humeral metaphysis with bone graft from the resected humeral head (Fig. 1). The implant does not violate the humeral diaphysis and does not have a diaphyseal stem. These fins have titanium porous and hydroxyapatite coatings to improve the biologic fixation of the implant. The metaphyseal bone quality or osteoporosis is not a contraindication for the use of this metaphyseal implant when the bone graft impaction technique is used.

The glenoid baseplate has a central tapered screw (hydroxyapatite-coated titanium) with the largest core diameter of 9 mm and 2 additional antirotational screws, superiorly and inferiorly (Fig. 1, A and Fig. 2). The glenoid sphere is fixed with a Morse taper to the baseplate. The glenoid sphere is lateralized 3 mm from the glenoid face, this is built in the thickness of the baseplate and the gap between the baseplate and the glenoid sphere. The polyethylene humeral liners have 10° inclined shape, achieved by removing the redundant polyethylene walls inferiorly-medially and respectively on both sides. This provides a very low profile medially, which reduces the impingement between the polyethylene liners to the glenoid neck (Fig. 3, A). The humeral cut is performed at a 155° angle, with the final implant angle of 145° using the inclined liner.

The humeral liners can be dialed in a way that the correct version and offset of the liner can be determined and changed, and adapted to each patient even after the definitive metal implants have been implanted.

There are 2 glenoid sphere diameters and 4 different humeral liner offset options for each diameter.

### Surgical technique

The procedure is performed through the anterosuperior approach to the shoulder (Neviaser-MacKenzie approach).<sup>35,38,43</sup> In revision cases

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