Early To Medium Term Results of the Anatomical Total Shoulder Replacement

R Sloan, J Young, N Parker, I Nwachukwu

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Abstract

Introduction: We report the functional and radiographic outcomes of use of the modular Anatomical shoulder system (Zimmer) at our institution.Methods: A series of 33 shoulders (30 patients) where followed up for a mean of 37.4 months . Two patients died and three were lost to follow up. Pre-op diagnosis in the remainder was osteoarthritis (20), post-traumatic (6), and avascular necrosis (1). The mean age was 74 years.Results: Visual Analogue Pain (VAP) scores improved significantly ($p<.05$) from an average pre-op score of 8.8 to an average post-op score of 2.5. The mean post-op Disability of Arm, Shoulder and Hand (DASH) score was 38. The Modified Neer Rating for all was 11 excellent, 12 satisfactory, four unsatisfactory. Four cases showed signs of glenohumeral radiolucency but no evidence of progression. One periprosthetic fracture was managed successfully non-operatively. and one dislocation managed with closed reduction.Conclusion: The Anatomical total shoulder replacement provides satisfactory functional and radiographic outcomes and is readily achievable in this group of patients in the short to medium term follow up.

INTRODUCTION

Neer described the total shoulder replacement (TSR) in the 1970's with the addition of a glenoid component for shoulder arthoplasty([11]). Since then, there has been a progressive improvement, culminating in the concept of anatomical reconstruction of the proximal humerus and the concept of achieving anatomical replication continues to drive all enthusiasts in joint arthroplasty. The variations in shoulder design are no exception. These range from, cemented and un-cemented, modularity of offset and height, to resurface the glenoid or not, cemented and uncemented glenoid, glenoid components with pegs, keel, or screws to altered centre of rotation as in the reverse arthroplasty for rotator cuff arthropathy([2361415 16]). Other surgeons have used surface replacement implants with good results([59]).

Shoulder arthroplasty is performed for a number of reasons these include osteoarthosis, avascular necrosis, inflammatory arthritis and trauma. Neer ([11]) believed that implants with a design which mimicked the normal anatomy would provide the best function and durability. However second generation modular implants did not achieve reliable results([4]), and it has been the third-generation systems that have recreated structure and geometry which matches the normal anatomy to a greater extent than those of the second-generation ([13]) The Anatomical total shoulder replacement has been in use for a period of seven years. It aims to provide adjustability in the prosthetic head offset, neck angle and retrotorsion. The aim of this series is to provide early to medium term results of the Anatomical total shoulder replacement (Zimmer).

METHODS

Between February 2001 and November 2007, 33 consecutive Anatomical total shoulder replacements where performed. At the time of review two patients had died of unrelated causes (one of the dead patients had bilateral replacements) and three where lost to follow-up. The remaining 27 shoulders where all reviewed at a research clinic. We retrospectively assessed 25 patients (two bilateral) who had the above procedure performed. The primary clinical indication for surgery was pain with a secondary clinical indication of functional loss, and diagnostic indications for surgery were primary osteoarthritis, avascular necrosis (AVN) and trauma. Exclusion criteria included rotator cuff arthropathy, any signs of sepsis and neurological deficiency.

Patients where reviewed in a research clinic for assessment using the validated DASH score as a primary outcome

measure. Secondary outcome measures were pre and post-op visual analogue pain scores, radiological analysis based on three plain x-ray views (anteroposterior, axillary and scapular lateral) figures Ia, b, c, range of movement (forward elevation, lateral abduction, internal and external rotation), the modified Neer rating grade and complications. The radiographs were assessed for evidence of failure of fixation, radiolucent lines, and signs of osteolysis. Complications were obtained by direct questioning of the patients and by review of the medical records. The operating surgeon did not take part in post-operative assessment and a physiotherapist independent to the series helped collate the results.

All procedures were undertaken by the senior author (I.N.) via a standard deltopectoral approach. The glenoid was prepared, with reaming around a central glenoid wire positioned as close to the natural version of the glenoid as possible. The glenoid was then trialled and the appropriate sized component was fixed with four peg anchoring and impacted with cement into the key holes.

The humeral component is trialled using a trial head and test ball taper which is the attached loosely to the modular rasp. This helps achieve the appropriate anatomical orientation. The definitive head is then adjusted to the appropriate inclination, version and offset and then pre fixed to the ball taper component using an impactor. Having established the best fit version and inclination the head can then be finally impacted onto the chosen stem. The constructed modular implant is cemented under steady pressure until the undersurface of the head is resting on the humerus.

Post operatively all patients are provided with a polylsing for support. Physiotherapist guided active ROM exercises is commenced and patients are allowed to actively move there arm as pain and comfort allows after 24 hours. Patients have shoulder xrays taken the next day post operation out of sling and can be discharged that day if comfortable. All patients had uniform physiotherapy guided rehabilitation and follow-up from day one.

The results where analyzed by an independent statistician

Figure 1

Fig 1a: AP view of post operative Anatomical Total Shoulder replacement

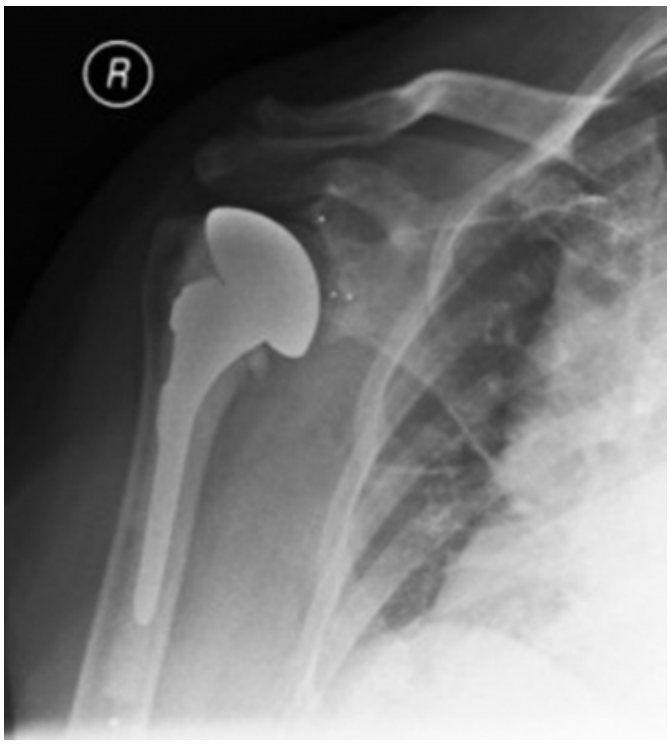


Figure 2

Fig 1b: Lateral view of post operative Anatomical Total Shoulder replacement

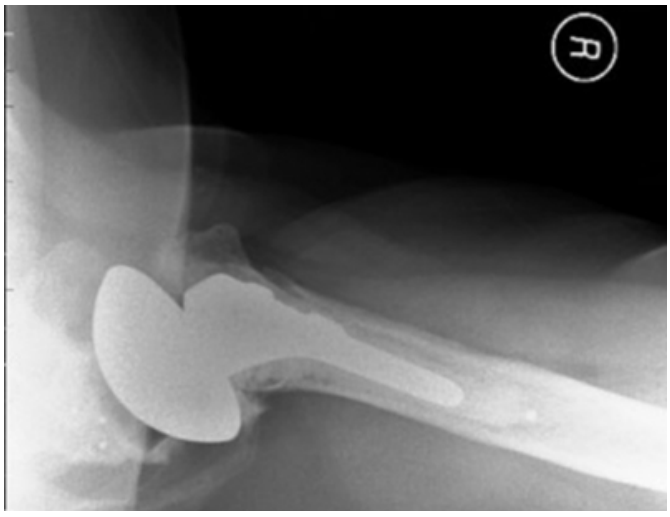
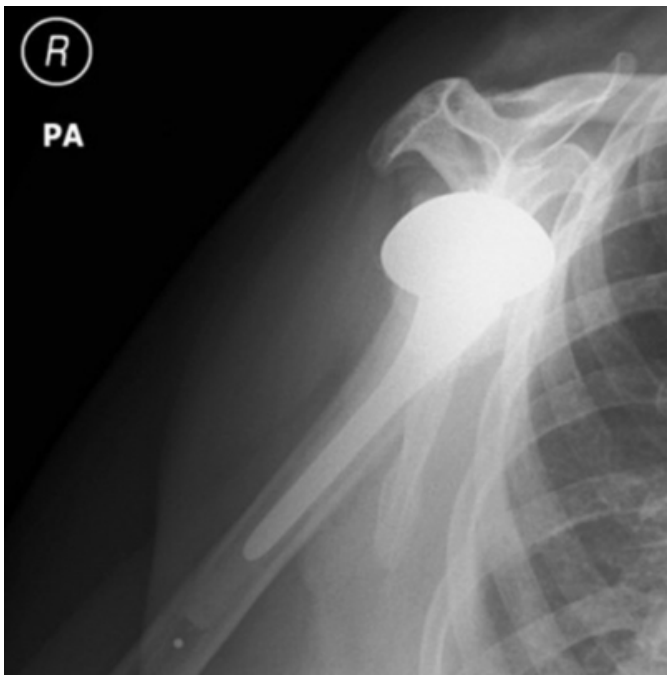


Figure 3

Fig 1c: Scapular Y view of post operative Anatomical Total Shoulder replacement



RESULTS

The mean time between surgery and review at the research clinic was 37 months (6 to 81 months). The age range was between 49 to 86 years, the mean age at operation was 74 years. Twenty five patients (27 shoulders) where available at follow-up. Indications for the procedure included 20 patients with glenohumeral osteoarthrosis, one patient with avascular necrosis of the humeral head and six patients for trauma.

The mean post-op DASH score was 38 (range 9-75) in total excluding trauma was 32.9 (range 9-74). Two patients died (one had bilateral replacements) and 3 were lost to follow up. There was a significant difference between the pre-op Visual Analogue Pain (VAP) scores, 8.8 (range 5-10), and post-op 2.5 (range 1-6) VAP scores for all. Excluding trauma the pre-operative VAP score was 9.1 (6-10) and post-operative VAP score of 1.9 (1-4) (table I). There was a statistically significant ($p<0.05$) difference between the two scores using the paired t- test. The Modified Neer Rating for all was 11 excellent, 12 satisfactory and four unsatisfactory (table one). Trauma cases had three satisfactory and three unsatisfactory. The average results for range of movement were forward flexion of 110 degrees, lateral abduction of 95.6 degrees, external rotation of 37.9 degrees, and 24 patients could internally rotate to lumbar vertebrae five and higher. The average range of movement improved if trauma patients were excluded but due to the small number of trauma patients this could not be statistically proven(table II). Radiographic analysis revealed four cases of glenohumeral lucency. No patient has had a revision for aseptic loosening or mechanical failure of the implant. There where no superficial or deep infections.

Complications included one unexplained myopathic muscle weakness (expectant management with physiotherapy achieving slow recovery), one peroprosthetic fracture managed non-operatively, one transient axillary nerve palsy, and one dislocation reduced closed. There was one humeral shaft perforation in a trauma case for malunion with secondary osteoarthrosis. No further intervention has been required in any of these cases.

Figure 4

Table I. Results for Anatomical Total Shoulder replacement

Average Post-op DASH score	VAS for pain		Modified Neer rating			Complications	Radiographic analysis
	Pre-op	Post-op	Excellent	Satisfactory	Unsatisfactory		
38	8.8	2.5	11	12	4	1 periprosthetic fracture 1 muscle weakness 1 dislocation 1 Axillary nerve palsy 1 humeral shaft perforation	4 cases of glenohumeral radiolucenecy

Figure 5

Table II. Average patient range of movement including and excluding trauma patients

All patients n=27	Patients after trauma excluded n=21
Forward flexion 110 degrees	Forward flexion 119 degrees
Lateral abduction 95.6 degrees	Lateral abduction 106.7 degrees
Internal rotation L5 and higher (24/27 patients)	Internal rotation L5 and higher (19/21 patients)
External rotation 37.9 degrees	External rotation 43.3 degrees

DISCUSSION

The results for the Anatomical Total Shoulder Replacement (ASR) appear favourable functionally and radiographically at a mean follow-up of 36 months. Generally patients with

osteoarthritis of the shoulder have obtained good results in this series, the poorer results are from patients who have had an ASR performed for shoulder trauma. This is in keeping with other series in the literature ([7]) .

There has been uncertainty as to whether replacement of the glenoid is associated with improved functional results due to documented high incidences of radiological lucency and potential loosening of the glenoid component, which gives concern as to the long-term survival of the component([6,10,12]). This common finding does not correlate with the requirement of revision surgery, which remains low ([11,7,18]). The overall balance of current research supports the concept of resurfacing both aspects of the joint as was carried out in this series ([11,7,18]). In terms of survival analysis, with revision as an end-point, no implant in the series has required revision and the current data does not demonstrate high early failure rates. Clinically, 85% of the shoulders remained satisfactory according to the modified Neer Rating. Of the four patients with evidence of glenohumeral lucency one case was glenoid and three were humeral. None of the four patients had radiographical evidence of subsidence or tilt, normal blood inflammatory markers and the four patients were pain free with no deteriorating function and where not deemed as at high risk for clinical loosening.

Achieving restoration of anatomy is the focus of this implant. The modularity allows alteration to the diameter, version and inclination for the humeral component(figures 2a, 2b, 2c). This can be achieved independently to the placement of the cemented stem. The head is also offset posteriorly and medially in a gradual adjustment which takes into account the size of the humerus. The slight mismatch between the radii of the glenoid and humeral components allows some degree of slide and roll to prevent shear loads. This can be trialled and also reassessed at the time of definitive component fixation. The soft tissue tension and their balance ultimately guide movement but the added modularity should allow an excellent estimation of normal anatomy for each case to achieve correct soft tissue tension.

Figure 6

Fig 2a: The modularity and design of the Anatomical Shoulder System allows a more accurate and reproducible reconstruction of the glenohumeral joint with the aim of restoring normal kinematics.

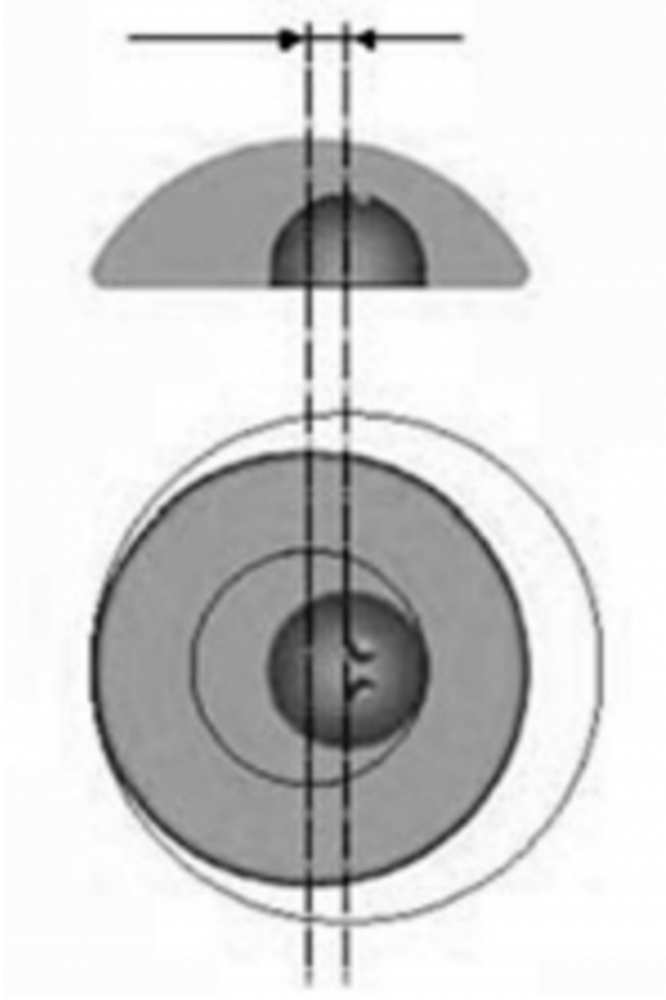
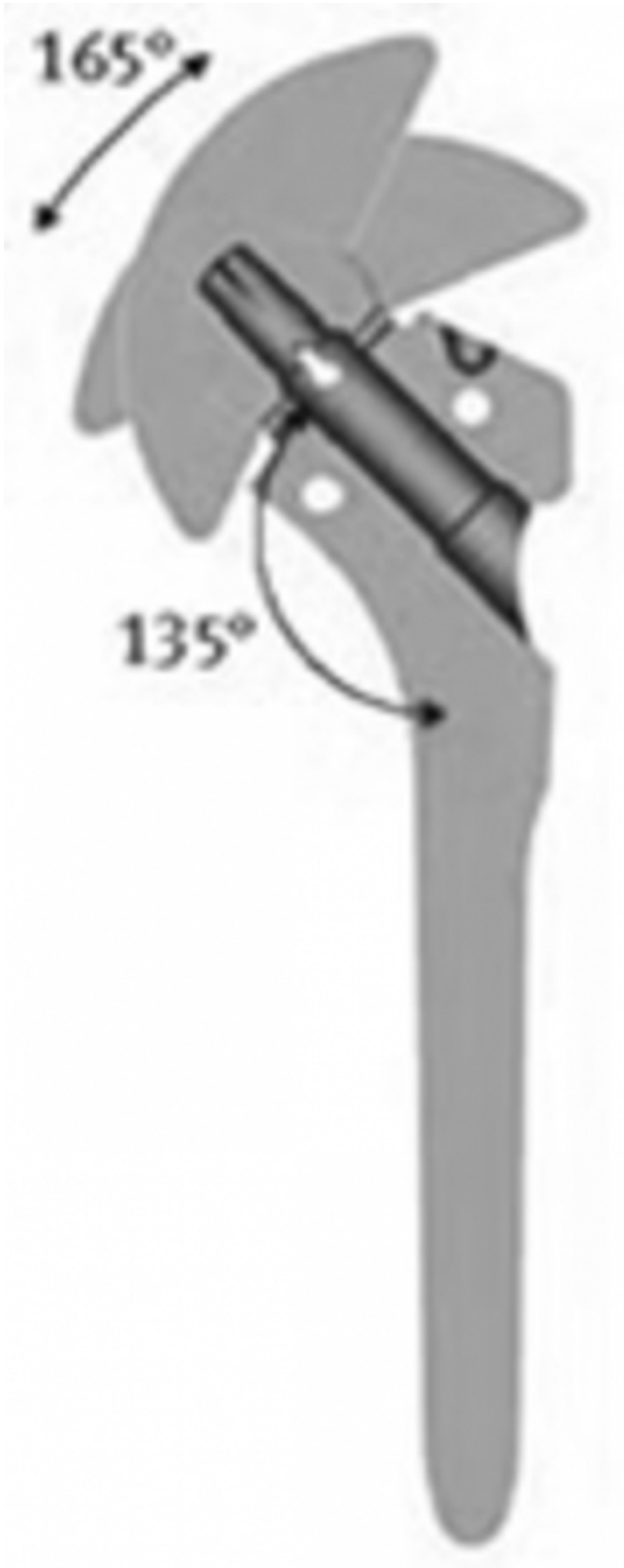


Figure 7

Fig 2b: ASR allows easy adjustability in version of humeral head. This can be adjusted between -30 to +30 degrees.

Figure 8

Fig 2c: ASR allows adjustability in humeral inclinaton.



We accept that there are some limitations to this study and that retrospective studies may be subject to recall bias. Pre-operative functional scoring would have added to this study but unfortunately this was not possible. The DASH questionnaire result by itself of 38 (32 excluding trauma) does not help prove how successful the procedure has been. Hunasker et al ($_{8}$) have suggested norms for the DASH based on 1700 individuals from the general USA population. We feel a measurement of 38 in this age group (average age 74) is acceptable. As measurement bias is more likely to occur in the post-operative assessment of data, the operating surgeon was excluded from this aspect of the study and a physiotherapist independent to the study was recruited to help collate the data. A statistician independent to the study was used to perform the statistical analysis. We also acknowledge the sample number and study design is insufficient to prove this prosthesis will outperform other published series for stemmed implants, but it does indicate that it is a reasonable technique with satisfactory results in patients with glenohumeral osteoarthritis.

This series demonstrates favourable results for the cemented Anatomical Total Shoulder replacement in patients with glenohumeral arthritis at early to medium term follow-up. Longer term follow-up will be required to assess its longevity but certainly early radiographic and functional results appear promising with relief of pain being a predictable result.

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Author Information

Roger Sloan, FRCS (Orth)
Consultant Orthopaedic Surgeon, South Warwickshire General Hospital

Jonathan Young, MRCS (Edin)
Specialist Registrar, Trauma and Orthoapedics Coventry and Warwick programme West Midlands

Nicky Parker, BSc (Hons)
Grad Dip Phys, Physiotherapist South Warwickshire Hospital

Ike Nwachukwu, FRCS (Orth)
Consultant Orthopaedic Surgeon, South Warwickshire General Hospital