Total Articular Replacement Arthroplasty

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ABSTRACT: Surface replacement, popularized in the early 1970s has fallen into disfavor by much of the orthopedic community. To date, the authors’ experience with 29 cemented total articular replacement arthroplasties (TARAs) in 25 patients has been quite favorable. Factors associated with these favorable results include: a physiologic age less than 60, good bone quality, viability of the remaining femoral head, and preservation of the acetabular subchondral plate. The mean age of cases in this study was 52 years, with patient follow up ranging between 3.5 and 7 years; there were two failures. Today, although conventional cementless total hip arthroplasty seems to be in vogue, real and potential problems exist. These concerns, in conjunction with the good results reported in this series, should encourage the orthopedic surgeon to take a second look at resurfacing arthroplasty, especially in the select group of patients defined in this article. Pending the long-term results of non-cemented prostheses the surgeon may even consider using cementless TARA components.

Introduction

The results of cemented conventional total hip arthroplasties in younger patients have been notoriously poor.1-6 Cementless conventional total hip arthroplasty may prove to be more beneficial. Certainly, some of the early reports have been quite encouraging. Nonetheless, there are problems. Persistent thigh pain has been seen in a number of patients. Potential problems include bead loosening and implant retrieval in the face of prosthetic and periprosthetic fracture.

While resurfacing arthroplasty was originally proposed as conservative, especially on the femoral side,7 clinical experience has shown that bone loss can be quite extensive on the acetabular side. This, in conjunction with early reports of failure,8,9 has resulted in the abandonment of resurfacing procedures by the majority of the orthopedic community. While there is much information in the orthopedic literature about resurfacing arthroplasties in general, very little is available on the total articular replacement arthroplasty (TARA). This article reports surprisingly good results using the cemented TARA. The purpose of the article is not to reclaim the TARA as the procedure of choice, but rather, attempt to understand the authors’ success with this implant.

Materials and Methods

From September 1979 to January 1983, a total of 350 cemented hip arthroplasties were performed at the authors’ institution. Of the 350 cases, 33 were total articular replacement arthroplasties. This represented 9% of all the total hips performed. Four patients were lost to follow up, leaving 29 hips for review.
Fig. 1: The TARA consists of a spherical metallic stemmed femoral cup and a corresponding polyethylene acetabular component that is eccentrically thickened superiorly to resist deformation.

The TARA consists of a spherical metallic fixed femoral cup and a polyethylene acetabular component\(^\text{10}\) (Fig. 1). It is available in eight matched sizes with head diameters ranging from 38 mm to 54 mm and the corresponding acetabular component outer diameter ranging from 47 mm to 63 mm. The articular surface of the femoral implant is spherical, while the inner anchoring surfaces represent a flat-topped cylinder for stable seating on the remodeled femoral head. The acetabular implant is eccentrically thickened superiorly for added resistance to deformation.

An anterolateral Watson-Jones approach was employed in all patients. In four cases, trochanteric osteotomy was necessary for purposes of exposure. All final components were cemented into place. Preoperative diagnoses included 19 patients with osteoarthritis, five with avascular necrosis, and one with ankylosing spondylitis. Selection criteria for the TARA were quite stringent, and based on preoperative and intraoperative requirements (Table 1). The preoperative requirements were a physiologic age less than 60 years and good bone quality.

The average age of cases studied was 52 years, with a range of 30 to 70 years. There were seven patients who were chronologically 60 years and older. Due to their high activity level, however, they were considered physiologically younger and thereby satisfied the preoperative requirement of being less than 60 years.

Good bone quality was the second preoperative requirement, and was assessed from an AP view of the hip using the Singh index. If the bony trabecular pattern revealed a Singh classification of less than IV, a TARA was not performed.

Even if the patients met the above preoperative criteria, a TARA was implanted only if the following intraoperative requirements were met. The remaining femoral head, after resection, must be viable. The best method to check for viable femoral head is to use a high speed bur and look for areas of bleeding bone. Another requirement is that the subchondral plate must be preserved during acetabular reaming. If this is not possible, the procedure is aborted and a conventional cemented total hip arthroplasty is performed. Preserving the subchondral plate, which is synonymous with preserving acetabular bone stock, is achieved by keeping the femoral component diameter to an absolute minimum. This was done by maximizing marginal head resection using a circular osteotome. One should strive for a femoral component with an inner diameter no more than 5 mm greater than the diameter of the femoral neck at its most narrow point (Fig. 2). In the present series, the femoral component diameter averaged 42 mm and the acetabular component diameter averaged 51 mm.

Results

The average follow up was 5 years, with a range between 3.5 and 7 years. Eighty percent of the patients were followed for more than 4 years. There were two failures (7%), one secondary to infection, and the other secondary to aseptic loosening. Preoperative Harris hips scores were 42; postoperatively, the scores were 90. Postoperative range of motion was quite good, with flexion averaging 100°, abduction 35°, adduction 25°, internal rotation 15°, and external rotation 25°. Excluding the two failures, quality of life was improved in all patients. All patients were able to return to their preoperative occupation.

J.G. is a 37-year-old salesman who was followed for the longest period, 7 years. He is status postfracture dislocation of the left hip requiring total
articular replacement arthroplasty 1 year later for avascular necrosis. Against the advice of his surgeons, he lifts weights four times per week, obviously over-stressing his joint (Fig. 3). Although any artificial hip implant is not suitable for these activities, it is encouraging that his x-rays at 7 years have shown no adverse changes (Fig. 4).

There were two failures in this study. The first was a deep infection (Fig. 5) which occurred at 6 months in a 35-year-old patient with ankylosing spondylitis. The components were removed and the patient subsequently sought further treatment elsewhere.

The second failure was secondary to aseptic femoral component loosening in a 51-year-old patient who underwent a left TARA for osteoarthritis. At 5 years postoperatively, he began to have progressive hip pain. The stem, which was initially placed in varus (Fig. 6A), is noted to have shifted a few degrees more (Fig. 6B). The sclerotic line paralleling the stem, also consistent with loosening should be noted. At the time of revision, the femoral component was grossly loose. Although the acetabular cup appeared to be solid, this was also revised and a cementless AML total hip was implanted (Fig. 6C). It should be emphasized that the revision surgery was fairly straightforward and uncomplicated with both the acetabular and femoral stock being preserved.

Twenty-two of the stems in this study were placed in neutral. Six stems were placed in valgus, and three were placed in varus. Other than the previously mentioned failure, stem position has not influenced results thus far.

Acetabular radiolucency was measured according to the method of DeLee and Charnley\textsuperscript{11} by comparing the initial postoperative films with subsequent films and those made at the time of most recent evaluation. A radiolucent line was absent or less than 1 mm in width in 14 hips, while in the remaining 15 hips, the width of the radiolucent line was 1 mm or more. In the second group, with at least 1 mm of radiolucency, five hips showed zone I and zone III involvement. In seven patients, zones II and III were involved. In three patients, radiolucency was seen in all zones. Thus far, the radiolucent lines have been nonprogressive.

**Discussion**

To date, there are only two reports in the literature dealing specifically with the TARA.\textsuperscript{8,9} Mallory reviewed 69 patients with an average follow up of 2 years and an average patient age of 55 years.\textsuperscript{9} Another report reviewed 67 patients with an average follow up of 3.3 years and an average patient age of 48.8 years.\textsuperscript{8} In our series, 29 hips were reviewed, with an average follow up of 5 years and an average patient age of 52 years.

In all three series, femoral stem failure has been infrequent (Table 2). The one femoral failure in
Fig. 4: Although the authors do not suggest that this implant is suitable for such an increased activity level, it is encouraging that the patient's x-rays at 7 years (A) continue to look as good as the one-year x-rays (B).

Fig. 4A.

Fig. 4B.

Fig. 5: This x-ray represents one of the two failures in this series. This was a deep infection which occurred at 6 months in a 35-year-old patient with ankylosing spondylitis.

Head's study was attributed to a technical error. Femoral stem shift, believed to be synonymous with impending failure, was seen by Mallory in 17% of the hips. He qualified this alarming figure by stating that in only 20% of the cases was the stem placed in the proper neutral position.

The present study significantly differs from the others regarding the acetabular side (Table 3). Although the present study did not encounter progressive radiolucency, it was significant in the other two studies, and ultimately resulted in a 10% acetabular failure rate in Head's series. The success of the present study is attributed to preservation of the subchondral plate. The preserved subchondral plate serves as a physiologic backing to support the thin polyethylene cup and protect the underlying cement mantle from increased stress. Additionally, by limiting acetabular reaming to the subchondral plate, acetabular bone stock is preserved—a key factor should revision become necessary.

One criticism of this study may be the small number of patients. However, this small number probably represents the reason for success. The stringent preoperative and intraoperative selection requirements clearly defined a subset of patients suitable for total articular replacement arthroplasty. To reiterate, the preoperative requirements are a physiologic age less than or equal to 60 years and good bone quality. Intraoperatively, the remaining femoral head must be viable and the acetabular subchondral plate must be preserved. The authors propose, therefore, that the TARA is a suitable implant for the active individual who is physiologically 60
Fig. 6A: A 51-year-old patient underwent a left TARA for osteoarthritis. At 5 years postoperatively, the patient began to experience progressive left hip pain. This initial radiograph demonstrates the femoral stem to have been placed in slight varus.

Fig. 6B: Note that the femoral stem has shifted into a few more degrees of varus. Also, note the sclerotic line paralleling the stem (arrows) which is consistent with the diagnosis of loosening.

years or younger. The poor results reported in the literature are acknowledged, but excellent results can be obtained if proper surgical technique is followed and the selection criteria presented here are adhered to. Ideally, these patients will go on living active lives with pain free hips. At the very least, it provides them with several years of increased physical activity. The problems inherent to cement, although only partly seen in this study, are certainly very real. Pending the long-term results of porous coated implants, the surgeon may consider using non-cemented TARA components. Porous coated implants, although not used in this study, afford the exciting opportunity to combine the biological advantages of bone ingrowth with the biochemical advantages of resurfacing arthroplasty. If and when revision is indicated, it can be performed with relative ease, provided the initial procedure had preserved a maximal amount of acetabular bone stock as described in this article.

Conclusion

The problems seen with resurfacing, especially on the acetabular side, were not seen in this study. The results, with careful selection criteria and preservation of acetabular bone stock, show reasonable success rates and non-catastrophic failure. This fact, in conjunction with the potential problems associated with cemented and cementless conventional hip arthroplasty, should encourage the orthopedic surgeon to take a second look at resurfacing arthroplasty in selected cases. Additionally, as cementless technology continues to advance, the surgeon might even consider using non-cemented TARA components.
TABLE 2

<table>
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<th>Mallory</th>
<th>Head</th>
<th>Present Study</th>
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<td>Stem failure</td>
<td>1.6%</td>
<td>1.5%</td>
<td>3.4%</td>
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<td>Stem shift</td>
<td>17%</td>
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TABLE 3

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<td>Progressive lucency</td>
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<tr>
<td>Failure</td>
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Editorial Discussion

**ORTHOPEDICS:** Are the authors still performing the procedure as described and is it indicated in any group of patients at this time?

**Cohn:** Yes, the authors still perform the procedure as described in this article, except it is done with cementless technique and porous coated implants. Although we are doing primarily cementless conventional total hip arthroplasties, the TARA is performed in those select patients who meet the preoperative and intraoperative criteria described in the article.

**ORTHOPEDICS:** How do the results of this procedure as described in this article and by others compare with the early results reported with cementless “conventional” hip arthroplasty?

**Cohn:** It is difficult to make this comparison because the 5-year follow ups of most cementless “conventional” hips are only now being presented. Nevertheless, based on our experience and that of our colleagues, the results of cementless “conventional”...
hip arthroplasty are quite good, at least early on. The two other reported series of TARAs discussed in this article do not compare favorably with cementless conventional hip arthroplasty at similar follow up periods. On the contrary, our experience with the TARA has been quite satisfactory. We must qualify this statement, however, since the TARA is performed only in a select group of patients meeting the specific criteria.

ORTHOPEDICS: In view of the constraints of bone resection and component size, how can this procedure be adapted to employ cementless techniques?

Cohn: Adaptation of cementless technology to the TARA should not be a problem. On the femoral side, the geometry of the prosthesis and the cylindrical machining of the bone is such that the femoral component is conducive to a press fit. Additionally, the entire undersurface is porous coated. Figures A and B died from a motor vehicle accident 2 years later. At the time of retrieval the prosthesis was solidly fixed. Histologic examination (Fig. 2) demonstrates bone ingrowth into the micropores.

On the acetabular side, employing the cementless technique should not result in significantly more consumption of bone stock than if the procedure was done with cement. Essentially, the acetabular component consists of a porous coated metal-backed cup.
Fig. 3A: Cementless acetabular component as viewed from the side. Note the porous coated surface and the two sharp fins for added fixation and rotational stability.

Fig. 3B: Cementless acetabular component viewed from the front (without polyethylene insert). Note the thickness of the metal and porous coating is slightly greater than that of a cement mantle.

with two sharp fins to control rotation and aid in fixation (Fig. 3A, B). Since the thickness of the metal backing (with porous coating) is only slightly greater than that of a cement mantle, the amount of extra acetabular reaming is minimal. With the cementless technique, reaming slightly through the subchondral plate to cancellous bone is not a problem, and is actually encouraged, so that bone ingrowth may be stimulated.