CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 441, pp. 221–226

Isolated Liner Exchange using the Anterolateral Approach Is Associated with a Low Risk of Dislocation

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Authors of reports on the outcome of isolated liner exchange for osteolysis and wear have reported high dislocation rates. Twenty-six patients (27 hips) with a minimum of 2 years of followup had isolated liner exchange for wear and osteolysis done using the abductor splitting anterolateral approach. The mean followup was 41 months. The average age at time of surgery was 51 years. Preoperative Harris hip scores averaged 70, and increased to 82 at the most recent followup. We observed improvements in pain and functional scores. The average operating time was 82 minutes, and the average blood loss was 255 mL. Only three (12%) patients required transfusion. No components were rerevised for aseptic loosening, and one patient (one hip) had a dislocation (3.7%). Isolated liner exchange for osteolysis and wear done using the anterolateral approach has a lower risk of dislocation than previously reported and provides substantial improvements in pain, function, and Harris hip score.

Level of Evidence: Therapeutic study, Level IV (case series). See the Guidelines for Authors for a complete description of levels of evidence.

Isolated liner and head exchange procedures more frequently are being used for the treatment of polyethylene (PE) wear and osteolysis. Until there is a bearing surface proven to survive longer with less osteolysis than metal-on-PE, the number of revision surgeries including liner exchange will continue to increase. Although isolated exchange has proven successful in treating osteolysis in select patients with better bone preservation and reduced morbidity compared with complete acetabular component revision,[12,23,24,29,32] some reports suggest a high dislocation rate from 15% to 25% in patients without previous instability and after liner exchanges.[8,16,21]

Our purpose was to examine the results in our practice of patients treated with isolated liner exchange for wear and osteolysis to determine if the dislocation rate was as high as recently reported by other authors.

MATERIALS AND METHODS

We reviewed 31 patients (32 hips) retrospectively who had isolated liner exchange from July 1997 to October 2001 for wear, osteolysis, or mechanical failure where instability was not a factor. The average age at the time of liner exchange was 51 years (± 12 years; range, 28–72 years). The average height, weight, and body mass index (BMI) were 172.72 cm (± 10 cm; range, 152.4–193 cm), 83.5 kg (± 15.9 kg; range, 56.7–124.7 kg), and 28 (± 4; range: 21–37), respectively. Two patients were lost to followup, two patients received a constrained liner at the time as the initial liner exchange, and one patient died. This left a cohort of 27 hips in 26 patients with minimum 2 years followup. The average followup was 41 months (± 12 months; range, 24–75 months). Of the 27 hips, 26 were revised for PE wear and one was revised for ceramic head fracture. Fourteen (54%) patients were men and 14 (52%) procedures were done on the right side. Two patients in this group had a history of dislocation, but were not excluded because their liner exchange was performed for PE wear and osteolysis, not dislocation.

The procedures were done by the same group of surgeons (THM, AVL) via the abductor splitting anterolateral approach as described by Frndak et al.[14] Osteolysis was recognized in 15 hips, and during liner exchange morselized cancellous allograft was packed into the available holes in the acetabular component (Fig 1). The remaining hips had either osteolysis without accessible holes in the acetabular component for graft insertion, minimal osteolysis where grafting was not employed, or were revised for symptomatic PE wear with pain and measurable wear on radiographic examination. The liner and head were exchanged. Multiple acetabular components and liners were used during this time frame (Table 1). There were 26 modular heads exchanged and one monoblock implant (AML®; DePuy, a Johnson &

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One or more of the authors (KRB, AVL, THM) own stock in and have consultancy agreements with Biomet Orthopaedics, Inc., Warsaw, IN.
Each author certifies that his institution has approved or waived approval for the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.
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DOI: 10.1097/01.blo.0000194091.10447.79

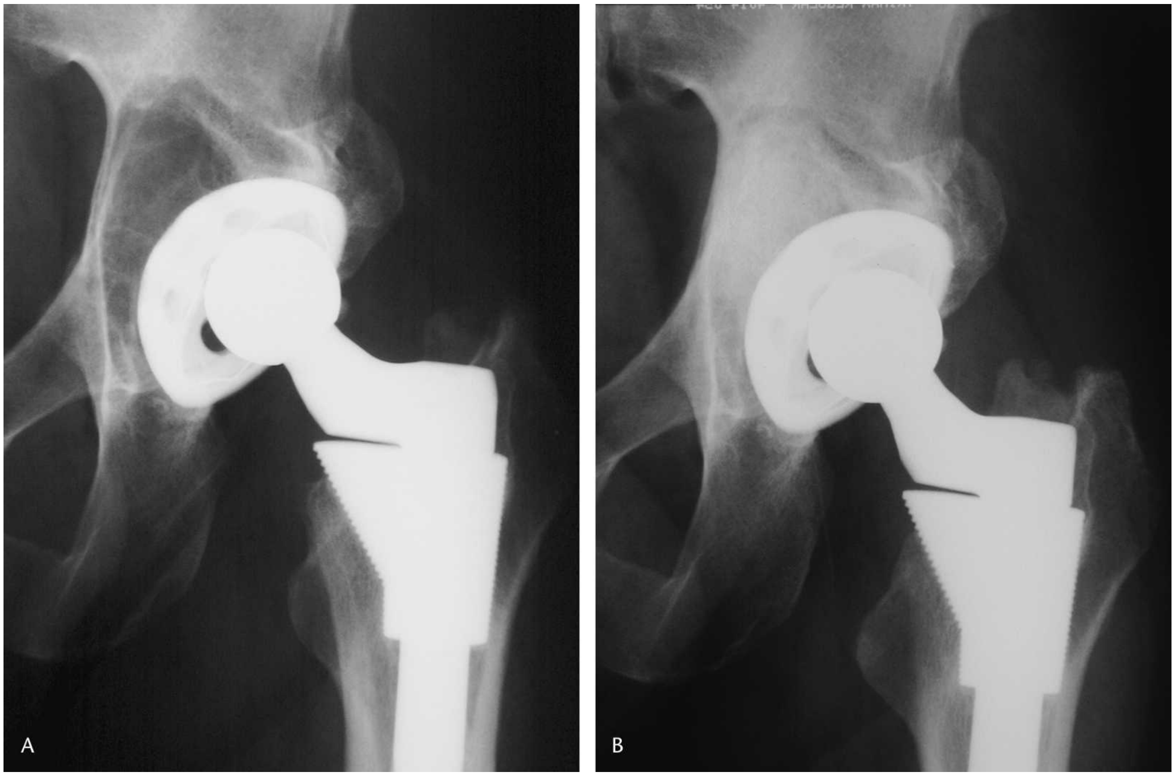

Fig 1A–B. (A) An AP radiograph of the right hip shows a 43-year-old man who presented with osteolysis secondary to PE wear 8 years after primary cementless THA. The patient had an S-ROM® femoral component (previously Joint Medical Products, Stamford, CT, now DePuy, a Johnson & Johnson Company, Warsaw, IN) with a 28-mm standard neck Co-Cr femoral head, and a DuraLoc® acetabular component with Hylamer® liner (DePuy) for treatment of posttraumatic arthritis. (B) A postoperative radiograph shows well fixed components and satisfactory positioning and alignment 44 months after the patient had surgical treatment of the head and liner removal, grafting with morselized allograft bone, and implantation of an Enduron® liner with a 28 mm cobalt chromium femoral head with a neck length of 3 mm.

Johnson Company, Warsaw, IN). The heads were made of either chrome cobalt or ceramic. Four femoral heads (15%) were downsized to enhance PE thickness; one from 32 mm to 28 mm, and three from 28 mm to 26 mm. The remaining heads were kept the same size (Tables 2, 3). Operating room time averaged 82 minutes, blood loss averaged 255 mL, and only 3 (12%) patients required a transfusion. Bone grafting was done on 15 (52%) of 27 hips for osteolysis at the time of liner exchange (Fig 1).

In the perioperative period patients were allowed to dangle, stand, and walk on postoperative Day 1. A cast brace was applied while patients were in the hospital and was worn for approximately 6 weeks.

All patients were evaluated preoperatively and at routine postoperative intervals using the Harris hip score. Pain, function, and subsequent surgeries were documented. All 26 patients (27 hips) had radiographs available at the time of review. The most recent radiographs were compared with the preoperative and

TABLE 1. Acetabular Components and Liners

Acetabular Component	Liner	Manufacturer	Hips (n)
Arthropor®	S-ROM Poly-Dial®	DePuy, a Johnson & Johnson Company, Warsaw, IN	11 (40.7%)
SuperCup®	S-ROM Poly-Dial®	DePuy, a Johnson & Johnson Company, Warsaw, IN	6 (22.2%)
S-ROM Custom Textured®	S-ROM Poly-Dial®	DePuy, a Johnson & Johnson Company, Warsaw, IN	1 (3.7%)
DuraLoc®	Hylamer® changed to Enduron	DePuy, a Johnson & Johnson Company, Warsaw, IN	3 (11.1%)
Mallory-Head HexLoc®	HexLoc®	Biomet, Inc., Warsaw, IN	1 (3.7%)
Mallory-Head RingLoc®	RingLoc®	Biomet, Inc., Warsaw, IN	4 (14.8%)
Harris Galante 1®	Harris Galante®	Zimmer, Inc., Warsaw, IN	1 (3.7%)

TABLE 2. Sizes of Femoral Heads before and after Exchange

Preoperative			Postoperative	
Head Size	*Hips (n)*	**Change**	*Head Size*	*Hips (n)*
22-mm modular	4 (15%)	Same	22-mm modular	4 (15%)
28-mm modular	20 (74%)	Same	28-mm modular	17 (63%)
		Decrease	26-mm modular	3 (11%)
32-mm modular	2 (8%)	Same	32-mm modular	1 (4%)
		Decrease	28-mm modular	1 (4%)
32-mm monoblock	1 (4%)	Same	32-mm monoblock	1 (4%)

sequential postoperative radiographs. Independent radiographic review was done by two of the authors not involved in the surgery (KRB and TMS).

Patients were identified by a query of records from our electronic medical record database (DocuMed, Inc., Ann Arbor, MI). Statistical evaluation was done using StatsDirect® software (StatsDirect, Ltd., Cheshire, UK). Student's t test, analysis of variance (ANOVA), and Mann-Whitney U test were used to examine differences between groups. All confidence intervals were calculated at the 95% level. Statistical significance was determined at $p < 0.05$. Power was calculated for all nonsignificant findings using 80% and an alpha of 5%.

RESULTS

Of the 26 patients (27 hips), one had a subsequent dislocation for a rate of 3.7% (Fig 2). The patient had revision arthroplasty consisting of liner and head exchange. This patient had dislocation after liner exchange had a history of previous dislocations (Fig 2). This woman was 51 years old at time of liner exchange, had Charnley classification A, a head diameter that remained 28 mm, a neck lengthened to 12 mm with a skirt, and retained a Mallory-Head RingLoc® cup (Biomet Orthopedics, Inc., Warsaw, IN). The survival of this patient's liner was 27 months compared with the average of 41 months for the nonrevised group. One patient required reoperation for a trochanteric avulsion secondary to a fall.

Ninety-three percent of the hips survived at an average of 42 months (± 11; range, 24–75 months). Two patients had reoperation at an average of 24 months (± 4 months; range, 21–27 months). No patients were revised for wear, loosening, or pain.

The preoperative Harris hip score averaged 70 (± 19; range, 33–100) and increased ($p = 0.008$) to an average of 81 (± 17; range, 47–100) at most recent followup. The preoperative pain score averaged 27 (± 13; range, 10–44) and increased ($p = 0.02$) to an average of 34 (± 11; range, 20–44) at most recent followup. The preoperative function score averaged 36 (± 8; range, 15–47) and increased ($p = 0.03$) to 40 (± 8; range, 21–47) at most recent followup.

Linear wear was exhibited at 47 months in one patient who had his revision for a ceramic head fracture. Otherwise, no patients had signs of wear or increasing osteoly-

TABLE 3. Neck Lengths before and after Exchange

Preoperative			Postoperative	
Neck Length	*Hips (n)*	**Change**	*Neck Length*	*Hips (n)*
−5 mm	2 (7%)	Decrease	−6 mm	1 (4%)
		Increase	Standard (0)	1 (4%)
Standard (0)	17 (63%)	Same	Standard (0)	6 (22%)
		Increase	3 mm	6 (22%)
		Increase	6 mm	4 (15%)
		Increase	12 mm	1 (4%)
3 mm	1 (4%)	Increase	5 mm	1 (4%)
6 mm	1 (4%)	Same	6 mm	1 (4%)
12 mm	1 (4%)	Same	12 mm	1 (4%)
Short	3 (11%)	Increase	Standard (0)	2 (7%)
		Increase	3 mm	1 (4%)
AML® monoblock	1 (4%)	Same	AML® monoblock	1 (4%)
Unknown Harris Galante®	1 (4%)	Not available	14 mm	1 (4%)

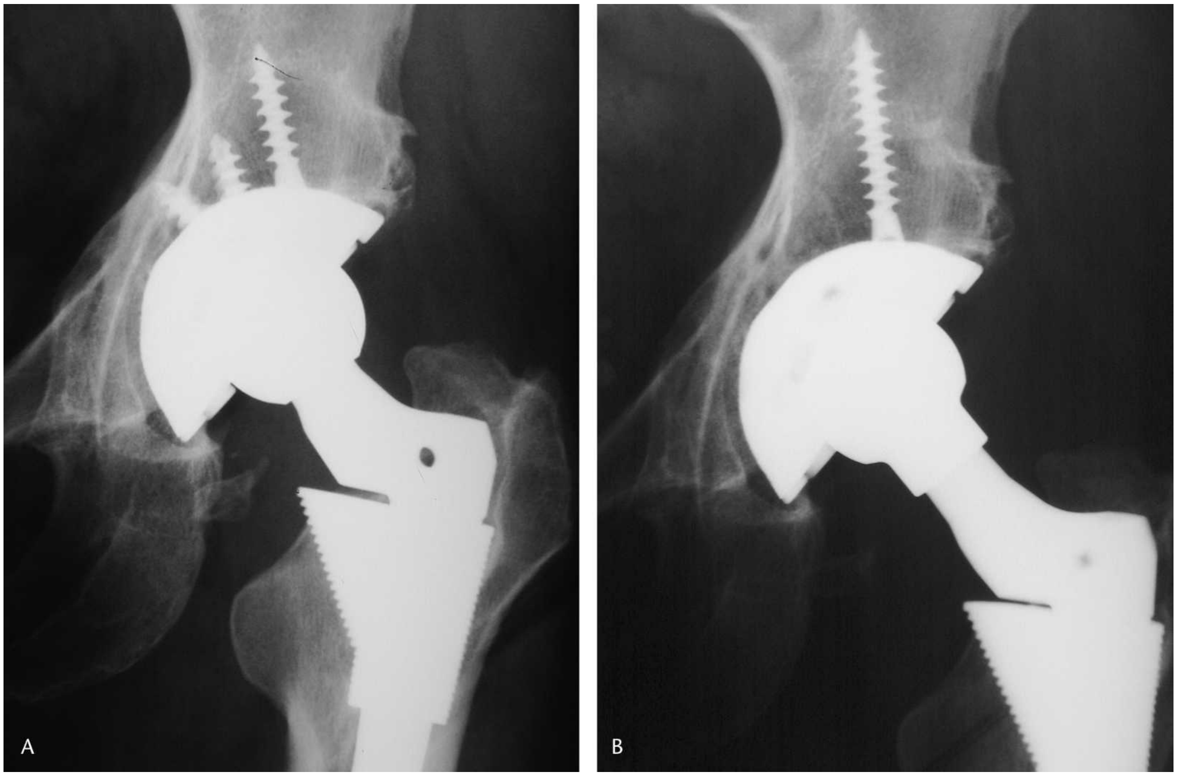

Fig 2A–B. (A) An AP radiograph of the left hip of shows a 51-year-old woman who presented with osteolysis secondary to PE wear 8.5 years after primary cementless THA. The patient had an S-ROM® femoral component, a 28 mm ceramic head with standard neck, and a Universal RingLoc® acetabular component (Biomet, Warsaw, IN) for treatment of rheumatoid arthritis. She had a history of acetabular fracture. The patient had a dislocation 2 weeks postoperatively and was treated successfully with closed reduction. (B) A radiograph taken immediately after revision surgery shows a change of the acetabular liner, and a change to a 28-mm Co-Cr femoral head with a 12 mm skirted neck. The patient experienced three dislocations beginning 2 years after the liner exchange surgery. The patient subsequently had a full revision of the acetabular component at another institution.

sis. There were no progressive radiolucencies or evidence of loosening.

DISCUSSION

For problems such as PE wear and osteolysis, isolated liner exchange is becoming more common, although this represents only a small percentage of revision surgeries.[18] Revision surgeries always have been associated with increased dislocation rates compared with primary total hip arthroplasty (THA) because of soft tissue disruption, the different components, and the surgical approach.[39] Dislocation ranks second for THA failure after aseptic loosening, with primary dislocation rates of approximately 0.3% to 11%, and revision dislocation rates as high as 26%.[2,6,13,17,30,35]

Authors of two studies suggest a low dislocation rate in primary THA associated with the anterolateral approach.[14,28] In the first study, one dislocation occurred in 65 hips (1.5%).[14] The second study involved a much larger series and authors reported 12 dislocations in 1518 patients after primary THA (0.8%).[22]

A negative aspect of the posterior approach includes, but is not limited to, the loss of the check rein of internal rotation by the capsule and the short external rotators.[6,22] Historically, the posterior approach has been associated with up to 5.9 times (3.2%) higher dislocation rates than the lateral and anterolateral approaches.[25] Masonis and Bourne[25] compared dislocation rates for the posterior approach with and without a formal posterior repair and showed that the dislocation rate was 4.0% without a repair and 2.0% with a repair. A decrease in dislocation rates has been reported with formal repair of the capsule and short external rotators, with early dislocation rates reported from 0% to 0.9%.[15,27,36,38] Wenz et al[37] reported one dislocation out of 124 (0.8%) mini-incision arthroplasties using the posterior approach. With the formal repair of the capsule and short external rotators, the dislocation rate with the posterior approach has decreased. Unfortunately, the new formal repair studies have small sample sizes and short followup compared with the studies of the lateral and anterolateral approach.[15,25,27,36–38]

Importantly, dislocation rates for the posterior approach in revision surgery have been significantly higher.[39] This is likely multifactorial, but may be related to the difficulty encountered with formal repair. This is especially true in cases of isolated liner exchange. Boucher et al reported a 25% incidence of instability following liner exchange performed via the posterior approach.[8] From the same institution, Terefenko et al[32] studied wear of PE liners inserted during liner exchange and noted a 10% rate of subsequent dislocation.[32] Griffin et al[16] noted an 18% rate of dislocation following modular component exchange for osteolysis and PE wear, again through the posterior approach, in their series of 55 hips. Five of these hips dislocated multiple times and 3 hips required an additional revision procedure to address instability.[16] Unlike the posterior approach the anterolateral approach does not disrupt the posterior checkrein established by the scarred capsule which may explain why results obtained with the current approach appear to be superior to those previously reported.

Many factors influence dislocation in THA, but impingement is a main concern.[30] In our review, the patient who had a dislocation had history of instability and a 12-mm neck with a skirt. Skirted necks increase dislocation by decreasing range of motion (ROM) and increasing the risk of impingement leading to dislocation.[2,34] While a longer neck length increases tissue tension, the addition of a skirt can lead to early impingement on the liner. The added length also may result in a leg length discrepancy for the patient. Femoral neck length was increased in 58% of cases in the current series, likely aiding in hip stability. This small amount of intra-articular lengthening was well tolerated, with no patients reporting difficulty with a leg-length discrepancy postoperatively. Femoral offset, femoral head diameter and the head and neck ratio are also important factors in establishing stability.[2,3,5,6,9–11,19,26,28,30,31,33,34] Although the head-neck ratio was decreased in four hips when the femoral heads were downsized to enhance PE thickness for wear properties, the patients had no dislocations.

Liner exchange after ceramic head fracture is of concern. The only linear wear observed by radiographic review was in the patient who had a previous ceramic head fracture. Authors of case reports have observed the increase wear of the PE by the ceramic particles remaining in the effective joint space.[1,20] Fracture of a ceramic head is a rare but serious event which should be treated with synovectomy, liner replacement, head exchange, and close monitoring for loosening and wear.[1]

There are new concerns regarding the adequacy of any locking mechanism to be revised without substantial micromotion and possible increased backside wear. For this reason, some surgeons recommend cementing acetabular liners into an existing metal shell.[4,7,24,32] However, liner exchange should only be attempted when several criteria are met. The prerequisites for any liner exchange are a stable, well fixed acetabular component in satisfactory position, modular design, adequate PE thickness, no damage to the metallic shell, and an intact and functioning locking mechanism. The main indication for acetabular component retention and liner exchange is PE wear and osteolysis. Secondary indications include recurrent dislocations, early postoperative infections, and exchange during stem revision. The results of isolated liner exchange have been good with low rates of PE wear and resolution of osteolysis.[4,12,22–24,29,32]

One potential drawback to the current study is a relatively short followup period for discussion of longevity and therefore the longevity of the implants; also, the wear and osteolysis potential following liner exchange will require further followup. A second potential limitation to the study concerns the use of a cast brace postoperatively in these cases. All patients were fitted and placed in a cast brace after surgery. This may have aided in the stability achieved in this series. We did not monitor or document compliance with this bracing and therefore cannot recommend for or against its routine use. We no longer use the use of a cast brace routinely in these cases, except when a history of instability preceded the liner exchange, and we have not seen an increase in instability. An additional limitation to the current study is the use of a constrained liner at the time of revision in two patients. During the time of the current study, constrained devices were used if the patient was being revised from a successfully stable constrained device or when intraoperative stability could not be achieved. These two cases are not included in the statistical analysis of survivorship.

Isolated liner exchange through the abductor-splitting anterolateral approach combined with postoperative bracing is a beneficial procedure for the treatment of osteolysis and wear, with substantial improvements in pain and function, and a low risk of dislocation.

Acknowledgment

The authors thank Joanne Adams for her assistance in preparation of this manuscript.

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