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Risk factors for revision for early dislocation in total hip arthroplasty

Jonathan L Conroy FRCS (Orth) [1,2]
Research Fellow
Sarah L Whitehouse PhD [1,2]
Research Fellow
Stephen E Graves D.Phil(Oxon) [3]
Director AOA NJRR
Nicole L Pratt BSc Hons(Stats) [4]
Statistician
Philip Ryan FAFPHM [4]
Associate Professor in Public Health
Ross W Crawford D.Phil(Oxon) [1,2]
Professor of Orthopaedic Research

1. Orthopaedic Research Unit, The Prince Charles Hospital, Brisbane, Queensland, Australia.

2. Queensland University of Technology, Brisbane, Queensland, Australia.

3. Australian Orthopaedic Association National Joint Replacement Registry, University of Melbourne, Parkville, Victoria, Australia.

4. Data Management & Analysis Centre, Discipline of Public Health, University of Adelaide

Correspondence: Ross W Crawford [1]

Tel: +61 7 3139 4481

Fax: +61 7 3139 4043

E-Mail: r.crawford@qut.edu.au

Risk factors for revision for early dislocation in total hip arthroplasty

Abstract

Risk factors were investigated for revision for dislocation in primary THAs between 1/09/1999 and 31/12/2004 as reported by the AOA NJRR.

For 65,992 primary THAs the only initial diagnoses with significantly increased relative risk (RR) of revision for dislocation compared to OA were fractured NOF (RR 2.03, $p<0.001$), RhA (RR 2.01, $p<0.01$) and AVN (RR 1.57, $p<0.05$).

58,109 primary THA's for OA were investigated for effect of age-group, sex and fixation method. There were 428 (0.7%) revisions for dislocation, 369 (0.8%) with a cementless acetabulum and 59 (0.6%) with cemented, RR of 1.59 ($p<0.01$). There is a significantly increasing risk of revision for dislocation as head size decreases ($p<0.001$).

Cementless acetabuli, particularly with smaller heads, have a higher rate of revision for dislocation.

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Running head: Risk factors of revision for dislocation in THA

Introduction

Dislocation is one of the most common orthopaedic complications following primary total hip arthroplasty (THA).(1,2) Prevalence has been reported as being between 1% and 5%.(3-9) Approximately two thirds of cases can be treated successfully with a non operative approach. The remainder require further surgical intervention.(3, 10) The prevalence of dislocations requiring operative treatment ranges from 13% to 42%.(11-13) Surgical technique, implant design and patient factors have been suggested as risk factors.(13)

The Australian Orthopaedic Association (AOA) National Joint Replacement Registry (NJRR) commenced implementation in 1999 and has collected full national data since mid 2002 with a greater than 97% capture rate. All 289 hospitals (public and private) currently undertaking joint replacement surgery in Australia provide information to the Registry.(14) The 2005 report analyzed 101,952 hip procedures between 1st September 1999 and 31st December 2004 of which 65,992 were conventional primary total hip arthroplasties.

The purpose of this study was to use Registry data to investigate risk factors associated with dislocation of primary THA requiring revision. The data reflect current practice and include significant numbers of cemented, cementless and hybrid fixation.

Materials and Methods

Ethical approval was obtained locally at the Prince Charles Hospital and a formal request was made to the AOA NJRR for access to the national de-identified data. Analysis was confined to the conventional primary THA cohort to determine the risk

of revision across primary diagnoses. The outcome of interest was a revision procedure in which dislocation was listed as the reason for revision. Potential risk factors for revision for dislocation were examined, including age, sex, head size, method of fixation and the use of screws with cementless acetabular components, in patients with conventional primary THA with the diagnosis of osteoarthritis.

Data in the AOA NJRR are collected at the time of surgery using a standard paper based form. Each hospital subsequently forwards these forms to the Registry for data entry.(14) Forms with incomplete or inconsistent data are followed up by the Registry with the hospital concerned. Cases where forms have not been completed are identified by verification of Registry data using government separation data.

The AOA NJRR classifies revisions as major or minor. A major revision is defined as removal of a component that interfaces with bone i.e. either the femoral and/or acetabular component. A minor revision is where a major component had not been removed or replaced. Examples include exchange of an acetabular insert, femoral head, or both.

Statistical methods

Relative risks for dislocation were estimated using log-binomial models (generalized linear models with logarithmic link and a binomial error structure), adjusted for age, sex, and other potential confounding factors where appropriate. P-values and 95% confidence are also reported, without adjustment for multiple tests. All analyses were performed in SAS version 9.1 (SAS Institute Inc., Cary, NC, USA).

Results

During the period 1st September 1999 to 31st December 2004, the number of primary conventional THA recorded by the Registry was 65,992. Of these 58,109 were for osteoarthritis (26,889 (46.3%) males and 31,220 (53.7%) females). In Australia in recent years there has been an increase in the use of cementless fixation and a corresponding decrease in cemented fixation (figure 1). The diagnosis with the lowest risk of revision for dislocation is osteoarthritis. All other diagnoses have an increased risk when adjusted for age and sex, but this is only significant for fractured neck of femur, rheumatoid arthritis and avascular necrosis (table 1).

The conventional THA for OA cohort was extensively studied. Revision for dislocation occurred in 428 (0.7%) conventional primary THA for OA. Age and gender had no significant effect on revision due to dislocation (table 2). A positive trend of decreasing femoral head diameter with increasing revision rate for dislocation was identified ($p<0.001$) (tables 2 and 3). Cementless acetabular components had a higher risk of revision for dislocation compared to cemented acetabular components. This result was adjusted for age, sex and femoral head size (RR 1.59; 95%CI (1.19, 2.12); $p=0.002$) (table 2). Combining the effect of head size and method of fixation it is apparent that revision for dislocation increases dramatically with cementless acetabular fixation if a head size less than 28 mm diameter is used (table 3). Screw fixation of cementless acetabular components had no influence on the revision rate for dislocation (RR 0.93; 95% CI (0.75, 1.15); $p=0.49$) (Data not shown).

A large number of different prostheses were used in this cohort. There were 51 types of cementless and 41 types of cemented acetabular components as well as 87 different

cementless and cemented femoral stems.(14) Revision due to dislocation was highest with a cementless acetabulum combined with a cemented stem (0.9%) and lowest when both the acetabular and femoral component were cemented. (0.6%) (table 4).

Most revisions for dislocation following cemented conventional primary THA were major revisions (57.6%) (table 5). Major revisions were less common in the cementless acetabular group (45.5%). These differences were not statistically significant (p=0.08).

Discussion

The strength of this study lies in its prospective collection of detailed patient and operative data, allowing risk factors for revision associated with dislocation to be studied; in the large size of the cohort, allowing adequate precision of estimates of group differences; and in the unique opportunity for comparison of fixation techniques that the Australian Registry provides.

The weakness in the study is that the true dislocation rate is unknown. These data are not collected by the Registry. However, this study is different from many other studies on dislocation as we have concentrated on the most serious outcome of dislocation which is the requirement for revision surgery.

Advanced age has been associated with a higher risk of dislocation in some series (13,15,16) but a correlation between age and dislocation rate has not been demonstrated.(17-19) Our study confirms that there is no correlation with age and risk of revision following dislocation. Dislocation has traditionally been thought to be more common in women than men,(2) although there are studies that have refuted this.(17) Our results indicate that gender has no significant influence on revision for dislocation.

We are not aware that any previous study has identified an association between risk of revision for dislocation and the method of fixation used. We have demonstrated a higher risk of revision for dislocation when cementless acetabular components are used. There was an increased relative risk of 1.59 (95%CI (1.19, 2.12), p=0.002). (table 2). The majority of primary conventional THA in Australia are cementless and

the proportion of cementless procedures is increasing each year (14) (Figure 1). The increased rate of revision for dislocation may need to be considered by surgeons particularly in view of the increasing use of cementless acetabular components.

A significant trend ($p<0.001$) between a smaller femoral head diameter and an increased risk of revision for dislocation was found (table 3) with the cementless cups. This finding is comparable to other large studies investigating dislocation.(15) Berry et al.(9) in their study of 21,047 patients over a 30 year period was the first large study to demonstrate a direct correlation of femoral head diameter with risk of dislocation though this included early and late dislocations.

The rate of revision for dislocation when a cementless acetabular component was used doubled when a 26mm diameter head was used instead of a 28mm (0.7% for 28mm and 1.4% for 26mm ($p=0.02$) (table 3).

Use of liner exchange as a straightforward minor revision procedure might explain a higher revision for dislocation rate in cementless hips. However, there is evidence that this type of revision is not so straightforward. Blom et al.(21) in their study of acetabular liner revisions concluded that revision of an acetabular liner is not a benign procedure, reporting a 23% (3 of 13) complication rate in isolated revisions of liners. When combined with revision of the femoral component this complication rose to 48% (12 of 25). Boucher et al.(22) reported a 25% dislocation rate with isolated revision of a polyethylene liner, Earll et al.(23) a rate of 55% and Lachiewicz et al.(25) a dislocation rate of 18%. These high complication rates for so-called minor revisions should not be dismissed as insignificant.

The cohort of patients in the study was followed for a maximum of 5 years. Most series report the majority of initial dislocations to occur in the first 4 to 6 weeks after surgery.(6,7) However, Woo and Morrey (26) reported only 39% of dislocations in their series presented in the first 4 weeks and Berry et al. (27) showed a cumulative risk of sustaining at least one dislocation of 2.2% at 1 year, 3.0% at 5 years, 3.8% at 10 years and 6.0% at 20 years (this last group combines early and late dislocations the late ones occur commonly because of failure of the prostheses wear etc). Daly et al. (28) and Berry et al. (29) attributed instability after 5 years to soft tissue stretching or reduced captivation of a head by a worn cup. We would expect the majority of dislocations as a result of prosthesis design to be captured in this study. If the dislocation rate does increase significantly after 5 years we might speculate an even greater difference between fixation methods as a result of liner loosening and higher wear rates with cementless liners.(30- 32)

It is known that malalignment is associated with an increased risk of dislocation and probably increased risk of revision surgery following dislocation. In considering why there is a difference in the risk of revision surgery for dislocation between cementless and cemented acetabular components, an increased rate of malalignment is a possible cause. Although not supported by data in this study, we postulate that positioning of the acetabulum may be more accurate in cemented components. Paratte and Argenson (33) have also shown that 57% of uncemented cups inserted in the conventional way (and 20% navigated) lay outside the so called safe zone. When cementing an acetabular component small adjustments can be made during insertion and while awaiting polymerization. A cementless component has less adjustability as

it is inserted and certainly may change orientation from the most desired position in the final stages of seating of the component. We believe it is technically easier to ensure that a cemented acetabular component is optimally positioned compared to a cementless component. Injudicious use of lipped liners in order to compensate for errors in positioning of cemented cups could potentially result in excessive impingement and exacerbate a malalignment problem with respect to dislocation risk.

Shon et al (34) in their study of 162 retrieved cementless acetabular components concluded that whereas the cause for dislocation is multifactorial, impingement between the components is a major contributory factor. More than a quarter of their cohort failed due to recurrent dislocation after a short duration (<5 years). 94% of implants removed for dislocation showed impingement compared to 41% revised for other reasons. Those revised for dislocation were more likely to show impingement over the entire rim to the outer edge. Yamaguchi et al (35) in their study of retrieved acetabular components concluded that excessive acetabular anteversion with posterior positioning of an elevated rim was responsible for a high prevalence (39%) of impingement. A large head / neck ratio reduces the risk of impingement. (34, 35) This study confirms the reduced risk related to the use of larger head sizes.

In conclusion, this is the largest study to examine risk factors involved in hip dislocation. The AOA NJRR is unique amongst other joint registries in its large number of cementless prostheses. Age and gender have no significant effect on revision for dislocation ($p<0.05$).

Decreasing head diameter is associated with an increased risk of revision for dislocation ($p<0.0001$). This is the first study to report that the use of a cementless acetabulum has a significantly increased risk of revision for dislocation compared to a cemented acetabulum (RR of 1.59 (95%CI (1.19, 2.12), $p=0.002$)). This difference is particularly evident with the combination of a cementless acetabulum with femoral head diameters of less than 28mm.

Tables

Table 1: Relative risk of revision for dislocation of primary total hip replacement by primary diagnosis (adjusted for age and sex)

Primary diagnosis	Revised not due to dislocation (%)	Revised due to dislocation (%)	Total number	Relative risk (95% CI)	p-value
Osteoarthritis	**642 (1.1)**	**428 (0.7)**	**58,109**	**1.00**	**-**
Avascular necrosis	37 (1.3)	32 (1.1)	2,810	1.57 (1.10-2.26)	0.014*
Fractured neck of femur	30 (1.6)	31 (1.7)	1,869	2.03 (1.41-2.94)	<0.001*
Rheumatoid arthritis	18 (1.6)	16 (1.4)	1,140	2.01 (1.22-3.31)	0.006*
Developmental dysplasia	7 (0.7)	11 (1.1)	964	1.78 (0.96-3.31)	0.069
All other diagnoses	10 (0.9)	13 (1.2)	1,100	1.61 (0.93-2.79	0.090
Total	**744 (1.1)**	**531 (0.8)**	**65,992**		

* significant at 5%

Table 2: Relative Risk (RR) for revision for dislocation by age, gender, head size and acetabulum fixation method.

	Level	RR	95% CI		Pr > ChiSq
Sex	Male	1.05	0.86	1.27	0.648
	Female	1.00	1.00	1.00	.
Head Size	22MM	3.11	1.95	4.97	<0.001
	26MM	3.02	2.14	4.25	<0.001
	28MM	1.76	1.30	2.37	<0.001
	>=30MM	1.00	1.00	1.00	.
Age Group	<50	1.00	1.00	1.00	.
	50-59	1.00	0.57	1.75	1.0
	60-69	0.96	0.57	1.62	0.881
	70-79	1.23	0.73	2.05	0.436
	80-89	1.49	0.87	2.56	0.147
	90+	2.41	0.95	6.14	0.065
Acetabular Component	Cementless	1.59	1.19	2.12	0.002
	Cemented	1.00	1.00	1.00	.

Table 3: Revisions of THA for OA due to dislocation by head size and fixation of the acetabular component

Head size	Cementless (%)	Cemented (%)	*p-value*
22 MM	15 / 1121 (1.3%)	15 / 1680 (0.9%)	*p = 0.26*
26 MM	78 / 5706 (1.4%)	13 / 1855 (0.7%)	*p = 0.02**
28 MM	222 / 29657 (0.7%)	31 / 5283 (0.6%)	*p = 0.20*
≥ 30 MM	53 / 12518 (0.4%)	0 / 260 (0%)	*p = 0.29*
p-value	*p < 0.001**	*p = 0.30*	

* significant at 5%

Table 4: Revisions f Primary THAs with a diagnosis of OA by fixation of both the acetabular and femoral components.

Acetabular Component	Femoral Component	Not revised (%)	Revised not due to dislocation (%)	Revisions due to dislocation (%)	Total
Cementless	Cementless	28,023 (98.0)	364 (1.3)	195 (0.7)	28,582
	Cemented	20,088 (98.3)	183 (0.9)	174 (0.9)	20,445
	Total	48,111 (98.1)	547 (1.1)*	369 (0.8)**	49,027
Cemented	Cementless	133 (97.1)	3 (2.2)	1 (0.7)	137
	Cemented	8,795 (98.3)	92 (1.0)	58 (0.6)	8,945
	Total	8,928 (98.3)	95 (1.0)*	59 (0.6)**	9,082
Total		57,039 (98.2)	642 (1.1)	428 (0.7)	58,109

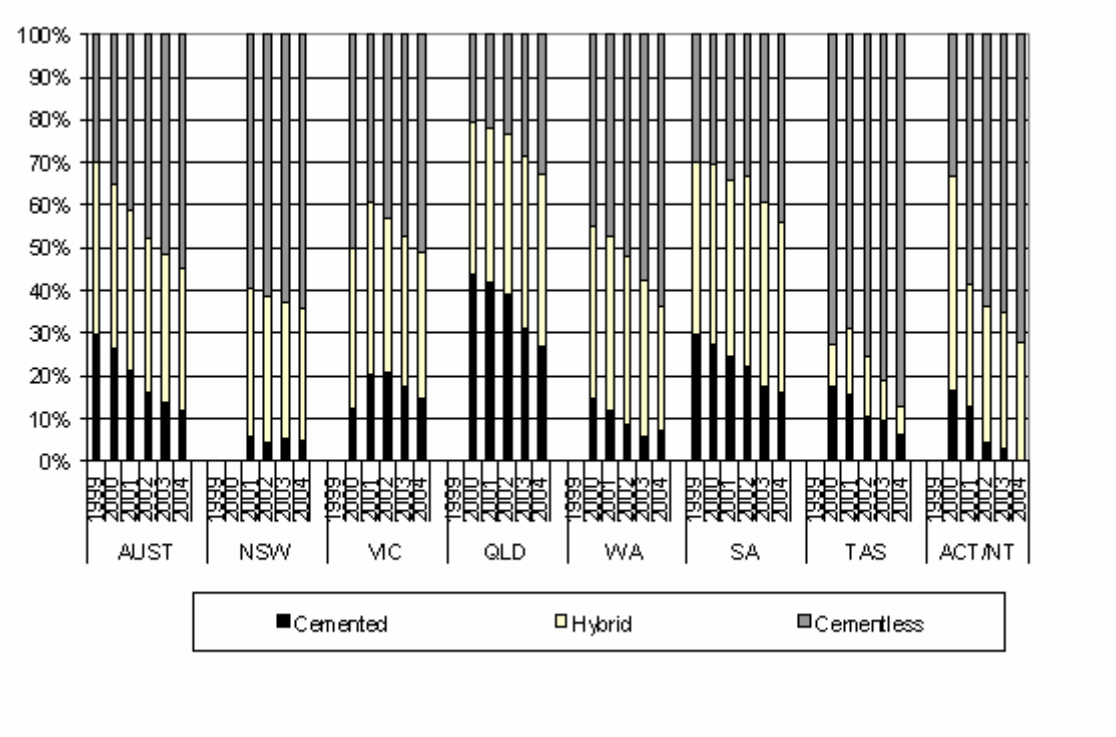
Significant ($p<0.05$)*, ($p<0.001$)**

Table 5: Types of Revision for Primary Total Hip replacements performed for Osteoarthritis due to dislocation.

Acetabular Component	Type of Revision Hip	Revised Not Due to Dislocation		Revised Due to Dislocation		Total	
		N	%	N	%	N	%
Cementless	Femoral Component Only	199	36.4	39	10.6	238	26.0
	Acetabular Component Only	106	19.4	116	31.4	222	24.2
	Femoral and Acetabular	63	11.5	9	2.4	72	7.9
	Removal Prosthesis	10	1.8	4	1.1	14	1.5
	Cement Spacer	33	6.0	.	.	33	3.6
	Cement Only	.	.	1	0.3	1	0.1
	Bipolar Head Only	1	0.2	.	.	1	0.1
	Head/Insert	77	14.1	151	40.9	228	24.9
	Insert only	13	2.4	14	3.8	27	2.9
	Head Only	23	4.2	33	8.9	56	6.1
	Cable/Other Minor Components	19	3.5	1	0.3	20	2.2
	Reinsertion of Components	3	0.5	1	0.3	4	0.4
	Total	547	100.0	369	100.0	916	100.0
Cemented	Type of Revision Hip						
	Femoral Component Only	25	26.3	2	3.4	27	17.5
	Acetabular Component Only	21	22.1	27	45.8	48	31.2
	Femoral and Acetabular	26	27.4	5	8.5	31	20.1
	Removal Prosthesis	4	4.2	.	.	4	2.6
	Cement Spacer	10	10.5	.	.	10	6.5
	Head/Insert	2	2.1	6	10.2	8	5.2
	Insert only	.	.	1	1.7	1	0.6
	Head Only	4	4.2	13	22.0	17	11.0
	Cable/Other Minor Components	3	3.2	5	8.5	8	5.2
	Total	95	100.0	59	100.0	154	100.0
Total		642	100.0	428	100.0	1070	100.0

Figures

Figure 1: Trends in Prosthesis Fixation – Primary Conventional THA in Australia by State and Territory (from AOA NJRR annual report 2005)



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