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Stability of hip hemiarthroplasties

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Abstract It has been stated in the literature that a bipolar hemiarthroplasty has a lower risk of dislocation compared to a unipolar hemiarthroplasty. As this statement has not been substantiated we undertook a systematic review of the literature of published articles from the last 40 years. In addition we used our own database of hip fractures. One hundred and thirty-three published articles were included in the review to give a total of 23,107 cases. The overall dislocation rate for all types of hemiarthroplasty was 791/23,107 (3.4%). An increased risk of dislocation was associated with a posterior surgical approach and the use of a cemented prosthesis. After adjustment for surgical approach and the use of cement there was no difference in risk of dislocation between unipolar and bipolar hemiarthroplasties. There was an increased risk of open reduction for a bipolar hemiarthroplasty.

Résumé Il a été affirmé dans la littérature qu'une hémiarthroplastie bipolaire à un risque inférieur de luxation comparé à une hémiarthroplastie unipolaire. Comme cette déclaration n'a pas été établie nous avons entrepris une révision systématique de la littérature pour étudier les articles publiés au cours des 40 dernières années. De plus nous avons utilisé notre propre base de données de fractures de la hanche. 133 articles publiés ont été inclus dans la révision pour donner un total de 23107 cas. Le taux global de luxations pour tous les types d'hémiarthroplastie était 791/23107 (3.4%). Un risque augmenté de luxation a été associé avec un abord chirurgical postérieur et l'usage d'une prothèse cimentée. Après ajustement pour l'abord chirurgical et l'usage de ciment il n'y avait aucune différence dans le risque de

luxation entre hémiarthroplasties unipolaires et bipolaires. Il y avait un risque augmenté de nécessité de réduction ouverte pour les luxations d'hémiarthroplasties bipolaires.

Introduction

Hemiarthroplasty of the hip is one of the most commonly performed acute orthopaedic operations, generally for an intracapsular hip fracture. Two main types of hemiarthroplasty are available, unipolar and bipolar. The bipolars have an additional articulating joint within the head, thereby allowing movement to occur both at the prosthesis acetabular interface and within the prosthesis. Unsubstantiated claims have been made that the bipolar prosthesis has a lower risk of dislocation than an unipolar hemiarthroplasty [6, 12].

Other factors that may influence the incidence of dislocation include the surgical approach to the femur and the use of cement. This study was to systematically retrieve all published reports of hemiarthroplasty to date to determine the incidence of dislocation related to the type of implant, surgical approach and use of cement. Additional information was used from our own prospective database of hip fractures treated at our institution over the last 12 years.

Patients and methods

A Medline and Embase search was performed using the keywords "hip" and "hemiarthroplasty". The search was restricted to English language articles in the last 40 years. For all retrieved studies the reference list was studied for any additional reports. Studies included were case series reports, comparative series and randomised trials involving all types of hemiarthroplasty. From all these studies the number of operations, type of prosthesis used and number of dislocations was noted. In addition, if given, details of the surgical approach used, use of cement, and the number of inter-prosthetic dislocations (for the

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bipolars) and the number of open reductions (as opposed to closed reductions) was noted. The type of implant was divided into unipolar implants and those with an inter-prosthetic articulation (bipolars). Surgical approach was divided into those via the anterior joint capsule and those via the posterior joint capsule. Those surgical approaches that involve detaching a small part of the greater trochanter to gain access via the anterior capsular were included in the anterior group. In addition the use of either cemented or un-cemented prosthesis was noted.

Information for hip fracture patients treated at Peterborough District Hospital has been recorded prospectively since October 1986. Data is recorded on all patients to achieve a consecutive series. Information recorded included the type of implant used, surgical approach and use of cement. All surviving patients are then followed up in a hip fracture clinic until 1 year from injury with record being made of the occurrence of dislocation.

Results were combined across studies by binomial regression, implemented using a generalized estimating equation, to allow for varying failure rates between studies. Results are presented as proportions and 95% confidence intervals (CI), or as odds ratios or failure and confidence intervals. *p*-Values relate to the Wald statistic for the relevant regression model, using the robust standard error. A *p*-value of less than 0.05 was considered statistically significant.

Results

From the literature review 133 reports involving 21,872 patients were retrieved. Eighty-four reports were for unipolar hemiarthroplasties and 49 for bipolars. These included case series reports, comparative series and randomised trials. All these studies gave the dislocation rate related to the type of implant used (unipolar or bipolar). In addition 84 of these reports gave details of the dislocation related to the surgical approach and 81 reports gave details on the use of cement. A further 1,235 hip fractures treated by a hemiarthroplasty were recorded from the database of our institution between the years 1986 and 2001. One thousand one hundred ninety-nine of these were unipolars and 36 bipolars. Eleven dislocations occurred for the unipolars and two for the bipolars.

In total the details of 23,107 patients treated with hemiarthroplasty were reviewed for which 791 (3.4%) prosthetic dislocations were recorded. Amongst 14,693 patients with unipolar prosthesis 581 dislocations occurred (3.9%, 95% CI 2.8–5.6%) and 210 dislocations occurred amongst the 8,414 patients with bipolar dislocations (2.5%, 95% CI 1.9–3.2%). The difference between these implants was statistically significant (*p*-value difference = 0.037).

Of the reports 84 gave information of the dislocations related to the surgical approach. Dislocation occurred in 397 out of 7,912 implants inserted via a posterior approach (5.1%, 95% CI 3.4–7.4%). For the anterior approach dislocation occurred in 128 out of 6,026 prosthesis (2.4%,

Table 1 Occurrence of dislocation related to surgical approach (percentage)

	Unipolar	Bipolar
Anterior	88/4,160 (2.1%)	40/1,866 (2.1%)
Posterior	315/5,129 (6.1%)	82/2,784 (2.9%)

Table 2 Occurrence of dislocation related to the use of cement (percentage)

	Unipolar	Bipolar
Cement	64/1,549 (4.2%)	93/2,773 (3.4%)
Un-cemented	102/5,173 (2.2%)	42/1,690 (2.5%)

95% CI 1.5–3.2%). The difference between these was again statistically significant (*p*-value 0.0026). Table 1 gives the results related to the type of implant. Statistical analysis indicated an interaction between surgical approach and polarity, which showed was no evidence of a differential effect between unipolars and bipolars (*p*=0.13).

Of the reports 81 gave information of the dislocations related to the use of cement. For the un-cemented implants dislocation occurred in 144 out of 6,863 cases (2.3%, 95% CI 1.6–3.1%). For the cemented prosthesis dislocation occurred in 157 out of 4,322 cases (3.6%, 95% CI 2.7–4.8%). This difference was statistically significant (*p*-value 0.027). However, there was no evidence of a differential risk with use of cement between unipolars and bipolars as detailed in Table 2 (*p*-value interaction 0.42).

Because of the association between dislocation and surgical approach and cement the analysis was taken using only those studies (37 unipolar, 26 bipolar) in which the surgical approach and use of cement were both given. Results are as shown in Table 3.

The effect of type of implant becomes non-significant on adjusting for the use of cement (odds ratio for dislocation 0.93 for bipolars compared to unipolars, 95% CI 0.58–1.50, *p*=0.78). Similarly, the effect of cement becomes non-significant on adjusting for surgical approach (odds ratio for failure 1.6 for posterior compared to anterior, 95% CI 0.95–2.70, *p*=0.075). The co-adjusted main effects of implant type, surgical approach and cement are given in Table 4.

Failure of reduction by closed means, which led to open reduction, was recorded in 79 cases. The incidence was 30 out of 581 (5.2%) for the unipolar prosthesis and 49 of the 210 (23.3%) for the bipolar prosthesis (*p*-value for the difference <0.0001). Inter-prosthetic dislocation with separation of the prosthetic head from the stem occurred in 26 (12.4%) of the bipolar dislocations.

Discussion

When the bipolar hip hemiarthroplasty was introduced one of its proposed advantages was that the double joint within the implant would reduce the risk of dislocation occurring [6]. Yassin and colleagues [12] speculated the high friction

Table 3 Dislocation related to surgical approach, use of cement and type of prosthesis (percentage)

	Unipolar		Bipolar	
	Cemented	Un-cemented	Cemented	Un-cemented
Anterior	22/945 (2.3%)	18/1,695 (1.1%)	33/1,205 (2.7%)	2/338 (0.6%)
Posterior	30/408 (7.4%)	47/1,834 (2.6%)	36/1,150 (3.1%)	31/790 (3.9%)

interface between the prosthesis and acetabulum prevents dislocation. They suggested that the bipolar prosthesis had a lower dislocation rate. Iorio et al. [6] also concluded that bipolar hemiarthroplasty should be used in patients with instability risks. However, neither of these reports provided any clinical data from comparison of bipolars and unipolars to support these claims.

The best method of comparing the stability of arthroplasties would be in a randomised trial using the same prosthetic stems with the only difference between the surgical procedures being the use of either a unipolar or bipolar prosthetic head. Only four such randomised trials have been identified [1, 3, 4, 8]. For these studies summation of the dislocation rate was identical for the unipolars (5/273 (1.8%)) and bipolars (5/280 (1.8%)) [9]. Whilst these randomised trials suggested no difference in the dislocation rate, because of the limited patient numbers we undertook this systematic review and meta-analysis of case series reports.

Initial viewing of the summation of the literature for this study suggested that the bipolars were indeed less likely to dislocate (3.9% vs 2.5%). However analysis of the data indicated that the use of cement and the surgical approach were associated with dislocation. When the figures were corrected for this it is apparent there is indeed no difference in the dislocation rate related to unipolar vs bipolar prosthesis. The most significant determinant of dislocation is the approach, with the posterior approach having a dislocation rate over twice that of the anterior approach. This finding has previously been demonstrated within a randomised trial [10] and comparative series [2, 7, 11].

Results from this study indicated that the use of cement was associated with a 1% increased in the risk of dislocation, although the difference did not quite reach statistical significance when adjusted for surgical approach. Why cemented prosthesis may increase the risk of dislocation difficult to determine? It may be that on cementing the prosthesis it may be placed in a position of excessive retroversion for a posterior approach or anteversion for an anterior approach. An un-cemented prosthesis may be able to rotate within the femur to achieve a position of stability. This would not be possible for a

Table 4 Adjusted odds ratio for risk of dislocation related to implant type, surgical approach and use of cement

Variable	Odds ratio	95% CI	p-value
Bipolar vs unipolar	0.89	0.53–1.48	0.65
Posterior vs anterior	1.77	1.11–2.84	0.017
Cement vs no cement	1.68	0.99–2.87	0.057

cemented prosthesis. D'Ambrosia et al. [5] postulated that cementing might prevent passive correction of the angle of the prosthesis within the shaft of the femur.

Within this study we were not able to look at other factors that may be associated with dislocation such as the exact stem type or experience of the surgeon. This is because these details were poorly documented. We were able to study the incidence of dislocation related to the decade to see if any change was occurring over the years. This was not apparent for either the unipolars or bipolars.

Open reduction was more common after bipolars. The figures given may represent an under-estimation of the true incidence of open reduction, as it may not have been reported in all studies. This also applies for the number of inter-prosthetic dislocations. Inter-prosthetic dislocation of a bipolar in which the head separates from the stem, invariably leads to open reduction. This may be less common now with many of the bipolar heads being factory fitted to prevent inter-prosthetic dislocation. An open reduction is still more common for a bipolar hemiarthroplasty even if inter-prosthetic dislocation does not occur, due to the movement of the bipolar head preventing reduction.

This study indicates there is no difference in the dislocation rate between a unipolar and bipolar prosthesis, but if a bipolar prosthesis dislocates then there is an increased risk of failure to reduce the prosthesis by closed means. There is an increased risk of dislocation with the posterior approach. To minimise the risk of dislocation of a hemiarthroplasty, a unipolar hemiarthroplasty inserted via an anterior-lateral approach is recommended.

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