



## Brief communication

## The prevalence of elevated-rim polyethylene liner use in primary total hip arthroplasty in the New York State metropolitan area

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## ABSTRACT

In existing radiographic studies on primary total hip arthroplasty (THA) examining the spino-pelvic effect on THA instability, there is no control of the type of polyethylene liner used, which may be a significant confounder of the results. We sought to determine the prevalence of the use of elevated liners in primary THA using regional implant company sales data. A total of 12,528 liners were analyzed, demonstrating that the overall regional percentage use of lipped liner use is high and varies inversely with larger head sizes. This prevalence data suggests that it is important to consider the use of lipped liners as a confounding variable that should not be overlooked in radiographic studies analyzing cup position and THA instability.

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## Introduction

The use of elevated or lipped polyethylene liners is an option that surgeons use to attempt to increase stability of a total hip arthroplasty (THA). In a large series, elevated liners were used in approximately 80% of primary THAs and clinically, elevated-rim liner dislocation rate was 2.19%, compared with 3.85% for standard liners at 2 years of follow-up [1]. Furthermore, an elevated-rim liner placed in the posterior quadrant from a posterior approach has been demonstrated to increase stability comparably to using a 32-mm sized head [2], and in the New Zealand registry data, shown to reduce the rate of revisions for instability regardless of head size including 36-mm diameters [3]. An emerging body of literature including radiographic studies on THA instability examining cup position (anteversion and inclination), and the dynamic spinopelvic effects on THA instability

have quantified the dynamic cup position in relation to spino-pelvic motion and identified increased risk of THA dislocation in spinal fusion and stiff spinopelvic motion [4–9]. However, in the majority of these radiographic studies, there is no consideration or control of the acetabular liner geometry, which may present significant confounding in the associations deduced. Understanding the frequency and patterns of the use of elevated liners in THA is important in defining the importance of lipped liners as a variable that should be controlled in studies investigating radiographic cup alignment and position as risk factors for THA instability.

## Material and methods

A retrospective analysis was performed using sales and distribution data of all polyethylene liners in New York State, from 3 major implant vendors: Zimmer/Biomet (Warsaw, IN), Smith and Nephew (Memphis, TN), and DePuy (Warsaw, IN) in the year 2017. The data obtained from Smith and Nephew and DePuy included the percentages of liner sales by inner diameter/head size. It is important to note that for each vendor, certain cup or head sizes did not allow for an elevated-rim liner option; however, the data on cup sizes for each liner sold was not provided by each of the 3 vendors.

Analysis was performed to compare the proportions of neutral vs elevated liner use, stratified by implant vendor and femoral head size. Chi-squared test was used to compare proportions of lipped

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liner use between the 3 vendors overall, and Pearson's correlation was used to test the relationship between head size and the proportion of lipped liner use for the 2 vendors whose data on head size were available. Statistical analysis was performed using SPSS version 23 (SPSS Inc., Chicago, IL).

## Results

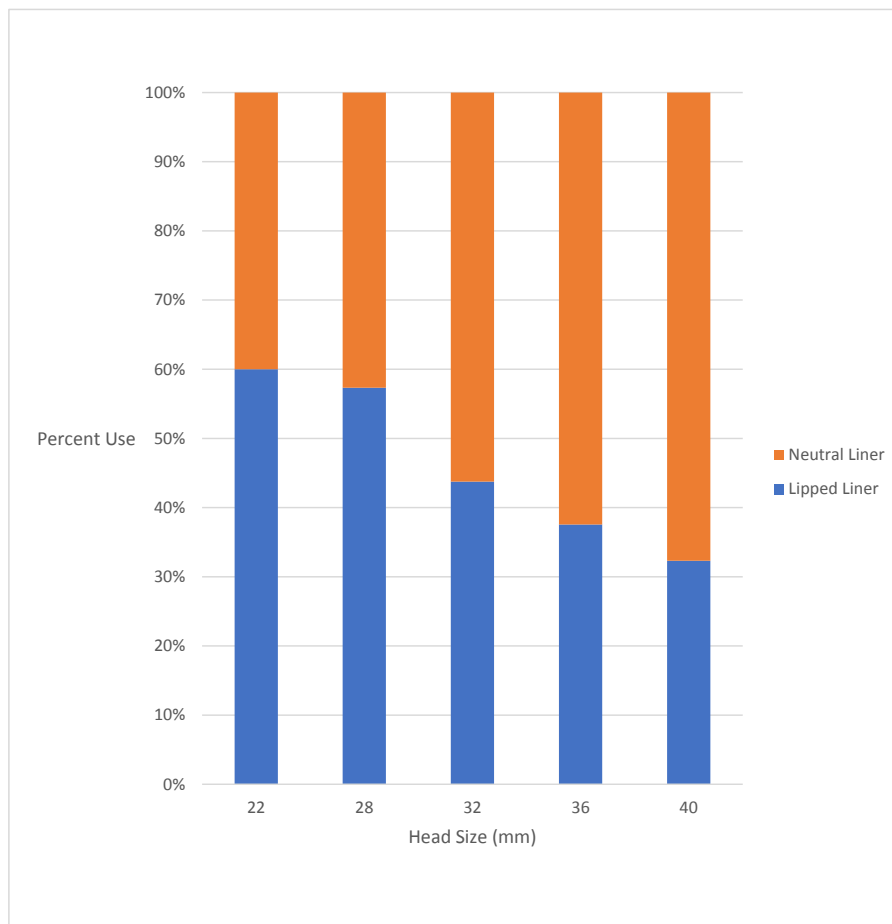
A total of 12,528 liners sold in 2017 by 3 major implant vendors were included in the analysis. The majority were neutral liners (8,379, 67%); however, a substantial proportion of 33% were elevated liners. The proportion of elevated liners sold by each implant company was statistically different (40.3% Smith and Nephew, 45.93% Zimmer/Biomet, 20% DePuy;  $P < .001$ ).

Head size data were available for 2 of the 3 implant vendors, allowing for stratification of the proportions of lipped liner use by head size (Figs. 1 and 2). Overall, the proportion of lipped liner use was higher in 1 vendor (Fig. 1) than the other (Fig. 2), and there was an overall general trend toward decreasing proportion of elevated liner use with increasing femoral head size in both vendors. This inverse correlation between increasing head size and decreasing use of lipped liners was statistically significant for 1 implant company (Smith and Nephew; Fig. 1) (Pearson correlation =  $-0.969$ ,  $P < .001$ ), but not for the other (DePuy; Fig. 2) (Pearson correlation =  $-0.321$ ,  $P = .599$ ).

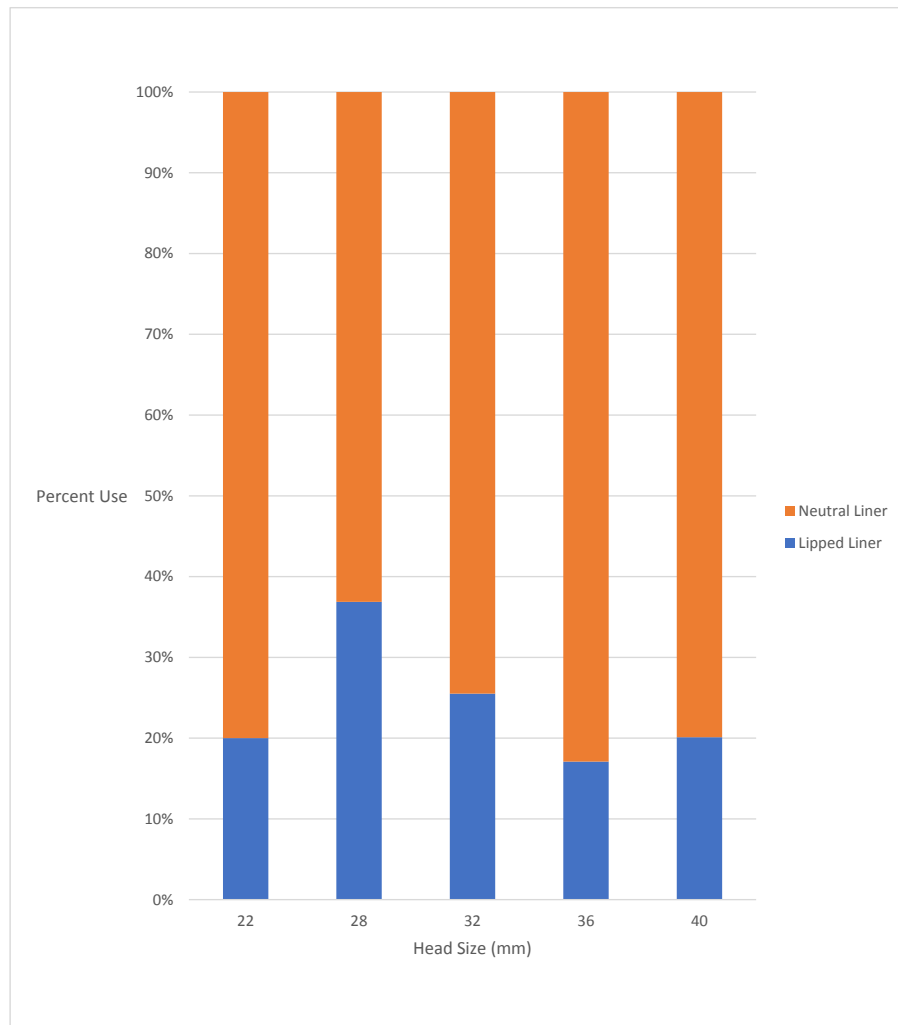
## Discussion

The regional prevalence of elevated liner use in primary THA was substantial across multiple implant vendors, but in different proportions. Our data demonstrate an inverse trend between head size and the use of elevated liners. To date, this is the only study in the literature examining regional prevalence of elevated liner use in primary THA. The percentage of elevated liners sold through 3 major THA implant vendors in New York State represented a notable proportion of all polyethylene liners sold in 2017, although overall, this represented a smaller proportion than neutral liners.

The theoretical advantages of using an elevated liner in decreasing the risk of THA instability have been demonstrated to be clinically evident, with decreased risk of revisions for instability, regardless of femoral head size [1,3]. Although theoretical concerns of acetabular component loosening exist with the use of elevated-rim liners, no clinical difference has been seen in component loosening or revision surgery in mid-term follow-up [10]. Furthermore, our data demonstrate that with larger head sizes, surgeons were less likely to use elevated liners, given the increasing inherent stability with larger head sizes. It is important to consider that elevated liner options do not exist in certain cup and/or head sizes depending on the manufacturer; however, data on cup sizes were not available in this study to consider in the analysis.



**Figure 1.** Percent use of lipped vs neutral liners from 1 implant company (Smith and Nephew), in New York State, in 2017, stratified by head size.



**Figure 2.** Percent use of lipped vs neutral liners from 1 implant company (DePuy), in New York State, in 2017, stratified by head size.

## Conclusions

The prevalence findings in this study hold important implications toward the interpretation of radiographically based studies on total hip instability. As demonstrated, the proportion of elevated liner use is considerable, at least regionally in New York State. Therefore, radiographic studies analyzing cup inclination and anteversion and the risk of THA instability, but not considering the liner geometry used, are likely subject to confounded results, given the existing evidence associating elevated liner use with decreased risk of dislocation. However, these data only represent regional patterns in the use of lipped liners, and we are now seeking data at a national level for external validity.

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