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Is resurfacing the patella cheaper? An economic analysis of evidence based medicine on patellar resurfacing

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ABSTRACT

Background: Primary total knee arthroplasty is a high volume procedure which is expected to grow dramatically in the near future. The decision to resurface the patella has been discussed extensively in the literature yet the financial implications of resurfacing versus not resurfacing have not been demonstrated.

Methods: We identified all randomized controlled trials comparing patellar resurfacing to nonresurfacing in the past ten years and identified the total number of patellofemoral revision surgeries for both resurfaced and nonresurfaced patellas in each study. An expected-value decision tree analysis was created using only data from the randomized controlled trials. Actual costs collected from Medicare reimbursement rates were then applied to the model and a sensitivity analysis was performed.

Results: The expected value of primary total knee arthroplasty with patellar resurfacing was $13,788.48 while a primary total knee arthroplasty without patellar resurfacing was $14,016.41 after five years. The difference represents an additional $227.92 of Medicare dollars for every primary total knee arthroplasty performed without patellar resurfacing at five years. The model remains valid as long as patellofemoral revision rates after patellar resurfacing remain below 3.54% and patellofemoral revision rates after nonresurfaced patellas remain above 0.77%.

Conclusions: While initially counterintuitive, resurfacing the patella during a primary total knee arthroplasty is the optimal financial strategy from a Medicare perspective over a mid term period.

1. Introduction

In 2007 in the United States 543,000 total knee arthroplasties were performed [1]. With the volume expected to grow to 3.48 million per year in 2030 the costs related to this procedure will undoubtedly have an economic impact on our healthcare system [12]. The decision to resurface the patella during a primary total knee arthroplasty remains controversial with studies supporting both resurfacing and not resurfacing the patella during primary total knee arthroplasty [3,13]. Traditional indications for both resurfacing and not resurfacing the patella during a primary total knee arthroplasty have been described by Burnett et al. [18] Physicians generally fall into three groups: always resurface, never resurface, or selectively resurface the patella.

With many outcome-based studies related to patellar resurfacing, complications associated with resurfacing the patella include patellar fracture, loosening, rupture of the patellar tendon, and polyethylene wear. In comparison, the main complication of a nonresurfaced patella is anterior knee pain which has been well documented [14]. These outcomes, in conjunction with those for resurfaced patellae, provide a frame work for the application of a decision tree with sensitivity analysis.

The goal of this paper is to provide a cost analysis to improve medical decision making through a combination of evidence based medicine, expected-value decision tree analysis, sensitivity analysis, and current Medicare data that provides an overall cost-savings to the healthcare system using the decision of patellar resurfacing in primary total knee arthroplasty as an index case. To our knowledge this is the first analysis of its kind to apply actual cost data to a decision tree analysis comparing resurfaced versus nonresurfaced patellae in primary total knee arthroplasty.

2. Decision tree analysis

Expected value decision tree analysis is a financial tool designed to produce the best economic decision possible given the information available. Since outcomes have inherent uncertainty and good decisions can lead to bad outcomes, the focus should be placed on the decision making process. The hallmark of a well-designed decision tree accounts for all available evidence based medicine, then quantifies the financial implications and determines the optimal strategy. Decision trees are composed of nodes and branches, where a node represents a point in time, or a decision to be made. A branch is simply a pathway that

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links possible decision nodes. With multiple branches possibly emanating from every node, a probability is applied to every outcome. The sum of the probabilities leading out of every node must sum to 1. This construct is very similar to the algorithms used in medicine every day, however, probabilities and financial values are embedded in every decision node. For every choice that is made, a quantifiable financial cost is incurred in conjunction with an estimated probability. The ability to correctly identify and appropriately apply associated costs with each decision node is important. The variance in costs over time can be accounted for and tested through sensitivity analysis. As the nodes and branches continue from left to right, the pathway will eventually end. This final node indicates that the problem is complete and all probabilities and costs have been computed. The two final values seen at the end node represent the final monetary value and probability of ascertaining the specific outcome.

3. Time value of money

The value of one dollar today is not the same as its future value. Costs must be discounted back to present values in order to objectively compare their true cost. When patient outcomes and financial implications are not realized until years later, the costs associated with those outcomes must be discounted to present day values. By the same token, costs realized in the future must represent future values. We elected to use 3.95% as our discount rate, which is the US Healthcare Inflation Rate as of June 30, 2012. (Bureau of Labor Statistics). Sensitivity analysis will be used given rates were recently as high as 5.16% in December of 2007 and as low as 2.6% in January 2009.

4. Sensitivity analysis

Healthcare outcomes and costs will inevitably change over time which will affect the decision tree model. Sensitivity analysis is an important component of any financial model prone to variations. As costs and/or probabilities change, each variable can be accounted for and the model is changed to evaluate the impact of each variable on the overall outcome of the model. Daellenbach et al. demonstrated the importance of sensitivity analysis in relation to decisions based on new orthopedic technologies with his example of the effect of survivorship and cost implications in cemented versus cementless total hip arthroplasty. However, since their model did not have reliable outcome data on failure rates of cementless prostheses, they relied exclusively on clinical judgment and sensitivity analysis for the assumptions created [4].

5. Methods & materials

We reviewed the literature for prospective randomized control trials as we well as meta-analyses over the past ten years from peer reviewed journals that compared patellar resurfacing versus not resurfacing during a primary total knee arthroplasty. Three meta-analyses and eight prospectively randomized control trials were found during our search [2,6–10,14–17]. However, we elected to use only six of the randomized control trials because of the poorly delineated methodology used in two. Each randomized control trial was evaluated to define the rate of reoperations in each cohort of patients with respect to patellar resurfacing versus not resurfacing and subsequent complications encountered in each study (Table 1).

Using the data collected we created an expected value decision tree model that evaluates two different strategies in respect to the patella during a primary total knee arthroplasty. The surgeon can either resurface the patella or choose to leave the patella alone. Resurfacing is defined as replacing the articular surface with an implant while not resurfacing does not utilize an implant but can include minor alterations such as removal of osteophytes and circumferential electrocautery of the patella. After the decision regarding the patella is made, the patient will fall into the appropriate limb of the tree. If a patient did

Table 1
Randomized control trials comparing total knee arthroplasty with and without patellar resurfacing.
Study data from the last 10 years.

Author	No. of knees	No. of knees resurfaced	No. of patella complications	No. of knees not resurfaced	No. of late resurfaced knees	No. of males	No. of females	Implant	Revision surgery	Study Conclusion	Follow Up
Breeman et al. JBJS Am 2011	1715	790	2 or 0.25% (both fractures)	867	23 or 2.65%	n/a	n/a	n/a	No difference	No benefit to resurfacing the patella. No significant effect on functional status, total treatment costs, or patient quality of life	5 years
Burnett et al. JBJS Am 2009	118	58	2 or 3.44% 1. Aseptic loosening 2. Patellar osteonecrosis → fracture → patellectomy → ext mech allograft	60	7 or 11.7% (all within 5–7 yrs)	n/a	n/a	Miller- Galante II	No Difference	Similar results achieved with or without patellar resurfacing	10 years
Smith et al. JBJS Br 2008	181	87	0	94	0	91	90	Profix (PF)	No Difference	No Difference in any measure. 22/73 (30.1%) AKP with and 18/86 (20.9%) AKP without (p = 0.183)	4.37 years (3-7 yrsyears)
Campbell et al. JBJS Br 2006	100	46	1 or 2.17% Instability (within 5 yrs)	46	2 or 4.35% (all within 5 yrs)	72	28	Miller- Galante II	No Difference.	No Difference Unable to recommend routine patellar resurfacing.	10 years
Waters et al. JBJS Am 2003	474	243	3 or 1.23% Instability – 2 Aseptic loosening – 1	231	11 or 4.76% (all within 2 yrs)	157	233	PFC	N/A	Resurfacing had better clinical outcome & non resurfaced had greater AKP (p < 0.0001) AND increased requirement for additional surgery (p = 0.0025)	5.3 years (2–8.5 yrsyears)
Mayman et al. J of Arthroplasty 2003	100	50	1 or 2% fracture (trauma)	50	2 or 4% (all within 2 years)	58	42	AMK	No Difference	No Difference	8-10 years