

# Does Orthopaedic Training Compromise the Outcome in Knee Joint Arthroplasty?

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**OBJECTIVE:** This study investigates knee joint arthroplasty and compares the outcomes between attending (consultant) orthopedic surgeons and resident (trainee) surgeons.

**DESIGN:** Retrospective review and comparison of knee joint arthroplasty outcomes between 4 surgeon groups (attending, supervised senior and junior residents, and unsupervised senior residents). Measured outcomes were implant survival (revision rate) and patient reported functional outcomes, measured by Oxford knee score (OKS).

**SETTING:** New Zealand arthroplasty service.

**PARTICIPANTS:** Seventeen years of knee joint arthroplasty data from the New Zealand Joint Registry (NZJR) was reviewed.

**RESULTS:** The New Zealand Joint Registry (NZJR) data showed 79,671 total knee arthroplasties (TKA) and 8854 unicompartmental knee arthroplasties (UKA) performed between 1999 and 2016. Attending surgeons performed 90% and 97% of TKA and UKA, respectively. The number and proportion of resident performed knee joint arthroplasty has decreased. Faster operation times was observed in the attending surgeon group. Attending surgeon revision rate was 0.49 and 1.19/100 component years for TKA and UKA, respectively, this was not significantly increased in resident surgeon groups. Postoperative OKS was 37.7 and 39.7 for attending surgeon performed TKA and UKA, respectively. Mean OKS were less than 2 points worse in resident groups (resident range: 36.3-36.9) compared to attending colleagues for TKA, but for UKA scores were up to 11 points worse (resident range: 28.9-38.8).

**CONCLUSIONS:** New Zealand has a high rate of attending surgeon performed TKA and UKA. Revision rates were

not increased in resident surgeon groups. Postoperative function was not reduced by a clinically significant amount in TKA in any of the resident surgeon groups but was reduced in supervised junior resident and unsupervised senior resident surgeon groups for UKA. (J Surg Ed ■■■■-■■■. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** knee joint arthroplasty, learning curve, functional outcomes, orthopedic training, resident surgeon

**COMPETENCIES:** Patient Care, Practice Based Learning and Improvement and Systems Based Practice

## INTRODUCTION

Surgical training is a complex challenge in health care systems worldwide.<sup>1</sup> Surgeon experience is fundamental for resident surgeons before qualifying as independent practitioners, however, patient care and service provision cannot be compromised.

The New Zealand orthopedic surgical training program follows a 5-year course which would commence the earliest at 4 years postgraduation. Residents (trainees) are considered senior (advanced) once they have completed their first set of examinations generally after 2 years. Residents are introduced to new surgical procedures as observers or assistants and as their experience progresses are expected to develop into independent surgeons. Almost all resident operating in New Zealand is performed under the supervision of an attending surgeon. The classification of “supervised” used in the New Zealand Joint Registry (NZJR) can range from the attending surgeon being a scrubbed assistant to being out of the operating room available to assist or complete the case if required. Unsupervised training opportunities exist where an attending surgeon allocates appropriate cases to an operating list that is

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completed independently by a senior resident with adequate experience.

The surgeon's operating experience and patient outcome has received increased attention recently. Working hour restrictions and reduced resident log book numbers can result in lower independent surgeon competency at completion of training.<sup>2,3</sup> It is important to note that poor surgical outcomes due to procedural learning curves are not isolated to resident but also affect attending surgeons.<sup>4</sup>

Joint arthroplasty has been identified as having a considerable learning curve.<sup>5</sup> To date, joint arthroplasty has not been well replicated by surgical simulation.<sup>5</sup> Hip joint arthroplasty was analyzed most recently by Reidy et al.<sup>6</sup> who performed a 10-year review of 584 cases, 43.6% of which were completed by residents. Revision rates and functional outcomes were not significantly different between the 2 surgeon groups.<sup>6</sup> Inglis et al.<sup>7</sup> analyzed total hip arthroplasty data from the NZJR and found that orthopedic training does not adversely affect Oxford hip scores or revision rate. Edelstein et al.<sup>8</sup> investigated the effect of resident involvement and perioperative complications in orthopedic surgery. Of 30,628 cases, 11,071 (36.1%) involved residents and the most common procedure was total knee arthroplasty (TKA) with 5638 cases (18.4%). The authors found that resident involvement did not increase readmission, 30-day mortality, medical or surgical complications. However, the surgical time was greater in cases involving residents (88 min compared to attending surgeons 71 min).<sup>8</sup> United Kingdom trainees (resident) have demonstrated no difference in radiological parameters, length of stay, transfusion rate, tourniquet time, or Oxford knee scores (OKS) in TKA compared to their consultant (attending) colleagues.<sup>9,10</sup>

Surgical outcomes and complications related to surgeon experience have been studied across a wide range of surgical specialties.<sup>8,11-15</sup> Studies in cardiothoracic surgery, colorectal surgery, and gynecological surgery do not show a significant increase in complications or poor outcomes with both supervised and unsupervised resident surgeons.<sup>11-15</sup> Increased surgical time among resident surgeons compared to their attending colleagues is a common finding.<sup>14,15</sup> One recent NSQIP database study assessed resident participation in a matched cohort of 83,790 commonly performed emergency procedures such as, appendectomy, exploratory laparotomy, and adhesiolysis. Resident participation was independently associated with longer surgical times, intraoperative, and postoperative surgical and medical events—wound, pulmonary, and venous thromboembolic complications.<sup>16</sup>

This study aims to compare the results for TKA and unicompartmental knee arthroplasty (UKA) between attending (consultant) surgeon and resident (trainee) surgeon groups using two primary outcomes: knee replacement survivorship, measured by revision rate, and the patient's reported function. We hypothesized that there would be no difference in these outcomes between groups.

## MATERIALS AND METHODS

A retrospective review of data from the NZJR on all elective TKA and UKA from 1999 to 2016 was performed. Data in the NZJR is collected from both the public and private sectors. A recent audit of the registry from 2013 showed a procedure capture rate of 98%.<sup>17</sup>

Data were collected across 4 surgeon groups where the principle surgeon was an attending surgeon (consultant), a supervised senior resident (advanced trainee), a supervised junior resident (basic trainee), or an unsupervised senior resident. Baseline data included: patient demographic, American Society of Anesthesiologists (ASA) score, and body mass index (BMI). Our primary outcome measures were arthroplasty survivorship, quantified by revision rate per 100 component years and patient reported functional outcome using the OKS.

The OKS is a validated, patient reported outcome questionnaire for knee arthroplasty. The score employs a 12 item, 48 point scoring questionnaire which patients complete to assess their pain and function. Since its development in 1998 it has undergone rigorous validation and is used in joint registries in England, New Zealand, and Sweden.<sup>18</sup> The NZJR sends OKS questionnaires to a randomly selected 20% of patients 6 months following their arthroplasty and of these 70% are completed and returned.

Baseline demographic data were first assessed to determine the comparability of all 4 surgeon groups. Then the revision rate and OKS for each group were directly compared. Secondary points of interest including number of cases in each group and surgical time were also compared.

## STATISTICAL METHODS

Revision rates were calculated from number of "events" (revisions) and sum total of all patients' follow-up years. CIs were estimated using a Poisson approximation. Independent *t* tests were used to compare OKS scores between surgeon groups. A 2-tailed *p* value of <0.05 used to indicated statistical significance. Regression modeling was used to adjust results for difference in age, ASA and BMI.

## RESULTS

### Baseline Data

Overall there were 79,671 TKA and 8854 UKA performed between 1999 and 2016 in New Zealand. The annual incidence of all knee arthroplasty increased on average 9% per year.

Baseline data showed that, with the exception of 1 small group (supervised junior residents UKA), the attending surgeon groups were younger, had lower BMI and lower ASA than resident groups, but the absolute differences were

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