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Original Article

Volume–outcome relationship in revision hip replacement – Results from a low volume hospital

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ABSTRACT

Introduction: Mortality and morbidity are both increased during revision hip surgery. Higher hospital procedure volumes have been associated with lower rates of mortality and/or complications according to some reports – the “practice makes perfect” hypothesis.

Aim: The aim of the study was to test “practice makes perfect” hypothesis with regards to revision hip surgery at our low volume hospital.

Methods: This is a retrospective study of all the patients who underwent revision hip arthroplasty under the care of the senior author between February 2002 and January 2006. Data was collected about the 30-day and one-year mortality, post-operative complications like deep vein thrombosis (DVT), pulmonary embolism (PE), superficial or deep wound infections, dislocations, and the Oxford hip score.

Results: The rate of revision hip surgery carried out in our hospital was 6.25 per year. There was no 30-day mortality, stroke within 3 months, dislocations within one year, re-admission within one month, one-year mortality and deep infections within one year. The final outcome after revision hip surgery, based on Oxford questionnaire, showed that 72% had an excellent outcome and 8% had poor outcome.

Conclusion: Volume and outcome relationship may not contribute towards the final outcome when individual surgeons and hospitals are considered. Good general hospital care can greatly affect the health outcome for a particular procedure. Strategies aimed at improving the general hospital care may benefit the patients as much as volume based regionalization.

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1. Introduction

Revision hip surgery is increasingly performed because of increased number of primary joint arthroplasties worldwide.

It is a major and a very challenging undertaking. Mortality and morbidity are both increased during revision surgery. Luft et al¹ in 1979 demonstrated that hospitals with larger number of patients with a specific diagnosis or procedure have lower

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mortality rates – the “practise makes perfect” hypothesis. A systemic literature review performed by Shervin et al² looked at the association between surgeon and hospital procedure volume and patient outcomes in orthopaedic surgery. The patient outcomes examined were mortality, hip dislocation, revision, complications, functional outcome, and satisfaction. Of the 26 articles reviewed, most examined outcomes after primary joint arthroplasties with a relatively limited number of studies examining revision arthroplasties. They found two studies^{3,4} that looked at the effect of surgeon volume and only one study³ that looked at the effect of hospital volume after revision arthroplasty. They found an association between higher surgeon volume and lower rates of mortality based on the two studies, but they could not conclude on any association between hospital volume and outcome after revision arthroplasty from one single study. All other associations were inconclusive because of limited number of studies.

2. Material and methods

The aim of our study was to test the “practice makes perfect” hypothesis with regards to revision hip arthroplasty (high-risk procedures) at our hospital (low-volume hospital). The study was carried out in a District General Hospital where all revision hip surgeries were performed by the senior author. It is a retrospective study of all the patients who underwent revision hip arthroplasty under the care of senior author between February 2002 and January 2006. The data was collected from the case notes and follow-up clinic letters. The inclusion criteria were patients who had revision of the hip arthroplasty for any reason, including patients who were converted from a hemiarthroplasty of the hip to a total hip replacement. The minimum follow-up period for inclusion was one year. We also included the patients who either had their femoral stem, acetabulum or both revised simultaneously. The revisions were done either in single, two or three stages. Patients with conversion of either total hip replacement or hip hemiarthroplasty to Girdlestone were excluded.

For all eligible patients the data was collected about the cause of revision surgery, the time of revision surgery since the primary surgical treatment, hospital stay, 30-day and one-year mortality, post-operative complications like deep vein thrombosis (DVT), pulmonary embolism (PE), superficial or deep wound infections, dislocations and the treatment received for these complications. The final outcome was based on the Oxford questionnaire that patients had answered during their follow-up visit.

3. Results

From February 2002 to January 2006, 22 patients underwent 22 revision hip replacements for septic or aseptic loosening, and 3 patients underwent conversion of hemiarthroplasty to total hip replacement. 10 (40%) patients were male and 15 (60%) were females with a male to female ratio of 1:1.5. The age range of the patients was 43–90 years with an average age of 74.6 years. There were 11 (44%) revisions carried out on the left limb and 14 (56%) on the right limb (Table 1). The rate of

Table 1 – Demographics of revision hip surgery.

	Revision hip arthroplasty n = 22 (88%)	Hemiarthroplasty to total hip replacement n = 3 (12%)	Total n = 25
Male	9 (36%)	1 (4%)	10 (40%)
Female	13 (52%)	2 (8%)	15 (60%)
Right Limb	12 (48%)	2 (8%)	14 (56%)
Left limb	10 (40%)	1 (4%)	11 (44%)

revision surgery carried out in our hospital was 6.25 per year. The average time between primary and revision surgery was 8.6 years (range 1–18 years). All procedures were planned revisions, with an interquartile range of hospital stay being 11 days (range 5–92 days).

The main cause of revision surgery was aseptic loosening of the prosthesis (76%) followed by septic loosening (24%). All the hemiarthroplasties of the hip converted to total hip replacement were due to aseptic loosening of the femoral prosthesis (Table 2) Superficial wound infections (12%) was the most commonly occurring complication (Table 3). All 3 cases of superficial wound infections were treated successfully with either oral or intravenous antibiotics. There was one (4%) case of post-operative chest infection and one case (4%) of post-operative upper gastrointestinal (GI) bleeding. The chest infection was treated successfully with appropriate intravenous antibiotics. The post-operative GI bleeding patient underwent upper GI endoscopy, which showed bleeding duodenal ulcer. This was injected with adrenaline and treated with proton pump inhibitor.

Two (4.5%) patients developed DVT following revision hip surgery, treated with warfarin and good outcome. There were 2 (4.5%) cases of prosthetic subsidence in revision hip surgery with poor outcome. One patient developed prosthetic subsidence of 2 cm within one year and considered for 2nd revision. In the second patient the acetabulum tilted and migrated proximally with development of a pseudo acetabulum. No further intervention was planned for him with a poor outcome. The conversion of hip hemiarthroplasty to total hip replacement was considered to be a safe operation as none of the complications examined occurred after the operation. There was no 30-day mortality, stroke within 3 months, dislocations within one year, re-admission within one month, one-year mortality and deep infections within one year. A breakdown of the revision procedures is provided in Table 4. The final outcome after revision hip surgery, based on Oxford questionnaire, showed that 72% had an excellent outcome and 8% had poor outcome (Table 5 and Fig. 1).

Table 2 – Causes of revision hips surgery.

	Septic loosening	Aseptic loosening	Other causes
Revision hips (n = 22)	6 (27.27%)	16 (72.72%)	Nil
Hemiarthroplasty to total hip replacement (n = 3)	Nil	3 (100%)	Nil
Total (n = 25)	6 (24%)	19 (76%)	0

Table 3 – Complications after revision hip surgery.

Complications	Revision hip surgery (n = 22)	Conversion of hemiarthroplasty to total hip replacement (n = 3)	Total (n = 25)
DVT/PE in 3 months	2 (9.1%)	Nil	2 (8%)
30 days mortality	Nil	Nil	Nil
Stroke in 3 months	Nil	Nil	Nil
Dislocation within 1 year	Nil	Nil	Nil
Re-admission within 1 month	Nil	Nil	Nil
1 year mortality	Nil	Nil	Nil
Deep infection within 1 year	Nil	Nil	Nil
Wound problems/superficial infections	3 (13.6%)	Nil	3 (12%)
Persistent pain following revision	Nil	Nil	Nil
Post-operative chest infection	1 (4.5%)	Nil	1 (4%)
Post-operative Gastrointestinal bleed	1 (4.5%)	Nil	1 (4%)
Prosthesis subsidence	2 (9.1%)	Nil	2 (8%)

4. Discussion

According to Scottish Arthroplasty Project Annual report 2009,⁵ there is a steady increase in the number of primary total hip replacements and total knee replacements since 1992. Because of this increase in primary arthroplasty the number of revision arthroplasty procedures is bound to increase over the coming years.

In 1979 Luft and his colleagues¹ focused attention on the possibility of a connection between an increased volume of clinical work and improved outcome. Since then, greater hospital and surgeon procedure volumes have been associated with lower rates of mortality and/or complications after different surgical procedures, including coronary artery bypass surgery,^{6,7} coronary angioplasty,⁸⁻¹¹ carotid endarterectomy,¹² abdominal aortic resection,¹³ cancer surgery,¹⁴ complex gastrointestinal surgery,^{15,16} liver transplantation,¹⁷ and cataract surgery.¹⁸ Since then, many further studies have reported this relationship. There is an increasing focus on indicators of outcome other than mortality.

Shervin et al² reviewed existing literature on associations between hospital and surgeon procedure volume and patient outcomes in orthopaedic surgery. The patient outcomes examined were mortality, hip dislocation, infection, revision, complications, functional outcome, and satisfaction. Of the 26 articles reviewed, most examined outcomes after primary joint arthroplasties (predominantly hip arthroplasties) with a relatively limited number of studies examining revision arthroplasties. They found an association between higher hospital volumes and lower rates of mortality and hip

dislocation. Katz et al¹⁹ in their study on an association between hospital and surgeon procedure volume and the outcomes of total knee replacement, concluded that patients managed at hospitals and by surgeons with greater volumes of total knee replacement have lower risks of perioperative adverse events following primary total knee replacement.

Is it the volume of activity for an individual surgeon or physician, which is important, or the volume of the relevant unit or hospital? More studies have looked at hospital volume than have looked at surgeon volume. There is evidence that each can be influential, with perhaps hospital volume stronger but there is no consensus. These results should be interpreted with caution because the possibility that other unmeasured confounders related to socioeconomic status or different factors are responsible for the improved patient outcomes rather than hospital specialization cannot be excluded.²⁰

It becomes a value judgement to explain the observed volume/outcome relationships. The two widely cited explanations are: 'practice makes perfect' and 'selective referral' (i.e. patients are selectively referred to clinicians or hospitals that have historically achieved good outcomes). The former would suggest that volume/outcome associations are causal but the latter would imply that the observed associations are artefactual rather than causal. There are also issues such as aspects of process and/or structure which are associated with high volume (e.g. a large well staffed intensive care unit) and which might lead indirectly to better outcomes.

Another issue is the fact that the volume/outcome literature looks at average effects. Although high volume is

Table 4 – Revision hips- breakdown of procedures.

Procedure	Number of patients
Acetabulum only with cement	9
Cemented Acetabulum and uncemented femoral stem	9
Cemented cup and cemented femoral stem	5
Femoral stem only using uncemented stem	1
Conversion of Austin Moore to Exeter Centrax hemiarthroplasty	1

Table 5 – Outcome after revision hip surgery based on Oxford questionnaire.

Outcome	Revision hip surgery (n = 22)	Conversion of hemiarthroplasty to total hip replacement (n = 3)	Total (n = 25)
Excellent	15 (68.2%)	3	18 (72%)
Very Good	3 (13.6%)	Nil	3 (12%)
Good	2 (9.1%)	Nil	2 (8%)
Poor	2 (9.1%)	Nil	2 (8%)

Fig. 1 – Outcome after revision hip surgery on Oxford questionnaire.

associated with good outcome in general, there are low volume hospitals whose outcomes are as good as typical high volume hospitals and there are high volume surgeons with poor results who work within high volume hospitals.

In a service increasingly taking account of patient choice, satisfaction with the whole process of care will need to be taken into account, with the potential of benefit from high volume, highly experienced specialized team care to be set against local familiarity, and convenience. As providers and payers are increasingly pressured to reduce health care costs while maintaining quality of care, volume–outcome research has assumed paramount importance. For policy-makers considering how to improve orthopaedic procedure outcomes, it may be appealing to mandate specific hospital or surgeon–volume cutoffs. Thus, restricting care to high-volume surgeons (a strategy known as regionalization) has been proposed to reduce the risk of orthopaedic adverse events in revision arthroplasty. Nonetheless, restricting specific orthopaedic procedures to high-volume centres or surgeons may diminish access to such procedures. Furthermore, if patients are directed to higher volume institutions, the increased volume may challenge or overwhelm the resources of such institutions, thereby rendering these procedures even less accessible. The other avenue to explore is to examine the process of care elements that result in improved outcomes in higher volume or more specialized hospitals and identify ways to transfer these improvements from these institutions to other hospitals. If successful, this would ensure continued access to speciality care at local hospitals and improve outcomes throughout the health system by closing the outcome gap.²¹

5. Conclusion

Our results show good outcome of revision hip arthroplasty in terms of mortality and major complications such as deep infections, DVT, PE, stroke and dislocations. Volume and outcome relationship may not be a phenomenon when individual surgeons and hospitals are considered. There could be a large degree of variation in health outcomes across various

hospitals and for various surgical procedures. Good general hospital care can greatly affect the health outcome for a particular procedure. Strategies aimed at improving the general hospital care may benefit the patients as much as volume based regionalization.

Since the data for this study were collected the senior author has chosen to stop revising total hip replacements, largely because of general questions about the appropriateness of this surgery in low volume hospitals, rather than concern about individual results.

Audit of a mentoring system, with staff from a low volume hospital working periodically in a higher volume institution, may give interesting results.

Conflicts of interest

All authors have none to declare.

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