Can the introduction of Enhanced Recovery After Surgery (ERAS) reduce the variation in length of stay after total ankle replacement surgery?

ABSTRACT

BACKGROUND

Enhanced Recovery After Surgery (ERAS) has been successfully adopted across a range of procedures. This study explores whether there is scope to improve length of stay (LOS) for total ankle replacement surgery (TAR) in the UK by implementing ERAS pathways.

METHODS

Hospital Episode Statistics (HES) data (April 2015/March 2016) on LOS for TAR were analysed. A literature search was then carried out to examine whether there were any publications on outpatient TAR and/or the use of ERAS protocols.

RESULTS

Mean observed LOS was 3.3 days (range 0 to 17.3) days. Case mix-adjusted expected LOS range was 2.0 to 5.7 days. It is likely that the wide observed LOS range is due to differences in local processes and pathways. Two papers were found by the literature search.

CONCLUSION

TAR should aim to be outpatient surgery as the literature, and data demonstrating scope for improvement in LOS, suggest this should be possible.

Keywords

Enhanced Recovery After Surgery; ERAS; Total Ankle Replacement; Length Of Stay

1. BACKGROUND

Osteoarthritis (OA) of the ankle is a disabling condition, with trauma such as fracture or severe sprain likely to be the main contributing cause[1]. In the UK about 29,000 cases of symptomatic ankle OA are referred to specialists each year, and at least 3000 cases are treated by surgery (ankle replacement and ankle arthrodesis) with marked variation in choice of operative treatment between surgeons)[2]. Until recently, arthrodesis (fusion) has been the usual treatment for end-stage OA, however total ankle replacement is becoming more recognised due to the introduction of a third generation of three-component mobile-bearing implants [3,4], and better operative techniques and training[5].

A review in 2013 [6] identified only six countries which collected data on total ankle replacement as part of their registry data, and so evidence on incidence of use and survivorship is limited. In England, Wales and Northern Ireland, data on primary ankle replacements have been reported in the National Joint Registry since 2010. Their 2016 report [7] records that over 500 primary ankle replacements have been undertaken each year from 2011 to 2015, with a maximum of 582 primary ankle replacements in 2015 In the US, a study by Singh and Ramachandran [5] using Nationwide Inpatient Samples (NIS) data reported an increase in utilization rates of total ankle replacement (TAR) from 0.13 per 100,000 in 1998 to 0.84 per 100,000 in 2010.

1.1 ERAS outcomes in orthopaedic surgery

Enhanced Recovery after Surgery (ERAS) (also called fast-track, accelerated recovery or rapid recovery) was first introduced by Henrik Kehlet [8], a Danish surgeon, who questioned why his abdominal surgery patients did not return home sooner from hospital. Its principles include reducing the surgical stress response, optimising pain relief, early mobilisation and empowering the patient to regain independence as quickly as possible following surgery.

ERAS has been successfully adopted across a range of different operative procedures [9-12], and there is strong evidence to support the use of ERAS pathways in orthopaedic surgeries such as total hip replacement (THR) and total knee replacement (TKR) surgery [13, 14]. Studies have shown that ERAS can reduce hospital length of stay to 1-3 days [15], with no negative effects on complications, readmissions and mortality rates [16]. ERAS has also been successfully adopted in revision surgery [17].

Successes in reducing length of stay have now raised the possibility of discharging THR and TKR patients on the day of surgery. Several studies have reported [18-21] on patients undergoing surgery in an outpatient setting and in Holland, Den Hartog et al [22], report that of 27 selected patients undergoing hip replacement, 24 were discharged on the day of surgery. This raises the question that if THR and TKR patients can be day-cases, can TAR patients also become day-cases?

Length of stay for TAR was reported as 2.5 days in 2010, a reduction of 0.5 days from 1998 [5], even though in recent years older patients and patients with higher

comorbidity (therefore likely to require more complex surgery) received TAR than in earlier years.

Although there are fewer total ankle replacements done in the UK compared to hip or knee replacements, there are strong clinical and economic arguments to support the introduction of ERAS principles to total ankle replacement (TAR) pathways as rates of the procedure are reported to be increasing [5,6].

This paper explores evidence for ERAS being used in TAR surgery by reviewing the literature and data on length of stay, and examines whether there is scope for improvement using ERAS.

2. METHODS

The methodology for this study was in two stages. Firstly, Dr Foster software [23] was used to retrieve and examine Hospital Episode Statistics (HES) data on length of stay for the OPCS coding O321 (primary total prosthetic replacement of ankle joint NEC) from April 2015 to March 2016. HES data include all inpatient and day-case activity from NHS hospitals in England, and are collected locally through each hospital's patient information system. Over 14 million records are gathered each year. From the data we identified observed and case-mix adjusted expected superspell LOS for 75 Trusts, and calculated mean LOS for these, and their standard deviation and range. Superspell LOS accounts for all related spells for a single patient during an episode of care, thereby taking into account the differing practices

of trusts in transferring patients from an acute setting to either rehabilitation or home. Definitions of outcomes can be found in Table 1.

Table 1: Definitions of outcome measures (Dr Foster[23])

Term	Definition
Superspell	Collected term of all the related, or linked, spells for a single patient. It is the time a patient spends within one hospital trust before being discharged. Spells are linked to superspells when: • they have same patient ID, or HES ID in HES years, when available • the discharge date of the first spell is within two days of the next spell
Superspell LOS	The number of days between date of admission in first spell and date of admission from last spell in superspell. It includes all patients apart from day cases so will include outliers (patients with long LOS and 0 day LOS).
Expected LOS	The England average LOS for inpatient superspells is adjusted for diagnosis/ procedures/Healthcare Resource Group, subgroup, age, sex, admission type, deprivation quintile and financial year and is applied as a benchmark to each patient. The overall figure for the selected patients is the average of the benchmarks. Benchmarks have been calculated for each of the years up to and including the latest complete year for which there is HES data.

Secondly a literature search was conducted in August 2017 to ascertain whether any evidence had been published on the use of outpatients or ERAS pathways in ankle replacement surgery, using the search terms in Table 2.

Table 2: Search terms used in literature review

(MM "Arthroplasty, Replacement, Ankle") OR "ankle replacement" OR "ankle arthroplasty" AND “enhanc* recover*” OR “fast track” OR “fast-track” OR “ERAS” OR “rapid surgery” OR “rapid-surgery” OR “accelerated surgery” OR “accelerated-surgery” OR “rapid recovery” OR “rapid-recovery” OR “early mobilisation” OR “early mobilization” OR “multimodal pain” OR outpatient* OR ambulatory Databases searched included Medline, CINAHL Complete, Cochrane Database of Systematic Review, PsycINOF, PsycARTICLES, and Science Direct (no filters were used)

3. RESULTS

3.1 HES Analysis

432 superspells were recorded from April 2015 to March 2016 under OPCS O231. No day cases were recorded. A mean observed LOS of 3.3 (range, 0 to17.3) days with standard deviation of 2.5 were found (see Table 3). The case-adjusted expected mean LOS was 3.1 (range, 2.0 to 5.7) days, with standard deviation 0.8.

Table 3: Mean, Standard Deviation (SD), Minimum and Maximum Length of Stay

LOS Superspells (days) for O321	Trust (n)	Mean (SD)	Minimum	Maximum
Observed LOS	75	3.3 (2.5)	0	17.3
Expected LOS	75	3.1 (0.8)	2.0	5.7

3.2 Literature Review

Importantly, the literature search only found two papers judged to be relevant to outpatient or ERAS concepts. A recent retrospective cohort study by Gonzalez et al [24] described the results of 21 patients with outpatient TAR, and compared them to 15 inpatient TAR patients. Patients underwent surgery under popliteal and

saphenous nerve block, and the postoperative pain management was described. 71% (15/21) of outpatient TAR patients were satisfied with their choice to undergo outpatient surgery, with 14% of patients (3/21) blaming poor pain control for their dissatisfaction. No acute complications were noted. They deemed outpatient TAR feasible in selected, well-informed patients with presence of support at home for postoperative care.

A second recent retrospective study by Mulligan and Parekh [25] compared TAR outpatients (n=13) with overnight (n=52) or extended inpatient stays (n=16) for medical and operative complications at 90 days, reoperations, readmissions and pain control. Early in the series reported, a transition was made to liposomal bupivacaine for regional anaesthesia, and all outpatients received this. There was a significant difference in complication rates, as 31% of those admitted for two or more nights had a complication, opposed to 5% of those who were outpatients or admitted overnight, but not for readmission or reoperation. There was no difference in pain scores at the first post-operative visit. The authors concluded that TAR was a safe and viable alternative to traditional inpatient admission.

4. DISCUSSION

The wide range of mean observed length of stays at trusts is unlikely to be due to case mix alone, as the range of case mix-adjusted expected LOS was 2.0 to 5.7 days. It is therefore likely that the range of observed LOS of 17.3 days is due to differences in local processes and pathways. Indeed, a recent report in England on

acute NHS trusts [26] has highlighted that although some local variation in practice can be justified, unwarranted variation affects patient outcomes, costs and productivity, and recommendations to disseminate best practice to trusts are being introduced through the GIRFT (Get it right first time) programme [27].

It may be that those trusts with a shorter LOS use multi-modal approaches to maximise patients medically and physically prior to, during and after surgery, and these multi-modal approaches could be seen to be analogous to an ERAS pathway. The lack of studies found in the literature search on the use of outpatient or ERAS pathways for TAR surgery indicates that further research is needed to explore whether components of ERAS are currently being employed by trusts, and, if so, the level of compliance in carrying out these components.

It should be noted too that the majority of sites performed less than 10 procedures a year. This low number of procedures may impact on the confidence of staff at sites in being able to perform early discharge of patients, and there is evidence that high-volume providers use resources more efficiently [28, 29].

4.1 Evidence to support application of ERAS components to total ankle replacement surgery

ERAS is a multimodal, multidisciplinary approach, where it is proposed that the aggregation of marginal gains achieved by combining all the ERAS components contributes to overall patient outcomes. We found two studies [24,25] introducing

ERAS concepts to TAR surgery, however the number of outpatients included was small, and the study designs were retrospective. Authors from one of the studies [24] suggest that for outpatient TAR to be successful, there needs to be strict patient screening; experienced operative teams and anaesthesiologists; and a good post-operative clinical support network.

There is more evidence on individual components of ERAS, one example is pain relief. A key factor in ERAS pathways is effective multimodal pain management which, when combined with other ERAS elements, enables more rapid recovery.

ERAS pathways are typified by the use of regional anaesthesia and analgesia over systemic opioids. A retrospective cohort study found that patients given continuous peripheral nerve block (CPNB) (n=24) for postoperative pain following TAR used less opioids in the 48 hours post-operatively than patients with no CPNB (n=54) (64.6mg in the CPNB group vs 129.6mg in the no CPNB group ($p<0.001$)) [30]. Length of stay also decreased to 2.9 days from 3.2 days although this wasn't statistically significant. Gallardo et al [31] also showed that a continuous popliteal block given to 22 TAR patients showed a significant improvement in pain control at 6, 12, 18 and 24 hours post-surgery, compared to 8 patients who received no block. The popliteal block group also used significantly less opioids than the no-block group and had a higher rate of patient satisfaction.

A recent review [32] of postoperative analgesia following TAR agreed that the continuous peripheral nerve block of both the popliteal and saphenous nerves had

high patient satisfaction levels. They concluded that long-acting local anaesthetics, such as liposomal bupivacaine, may extend the duration of analgesia without the need to use catheters, however further evidence in this area is required.

4.2 Preoperative education

Preoperative education is an important part of the ERAS pathway for THR and TKR, and is also likely to be beneficial for TAR surgery. Patients are provided with full details on their operation and recovery, how long they can expect to be in hospital, and requirements for discharge. Although a recent systematic review for THR and TKR [33] found no strong evidence linking preoperative education to pain reduction, LOS and morbidity for hip and knee replacement, preoperative anxiety was significantly reduced. A recent Cochrane review [34] concluded that preoperative education for THR and TKR was now so embedded within practice around the world that it could be seen as integral to the consent process.

4.3 Rehabilitation

Rehabilitation after TAR differs from THR and TKR, as the ankle is usually immobilised for around 2 weeks post-operatively, making it more difficult to mobilise patients full weight bearing early, as per THR and TKR ERAS protocols. There are no national guidelines on rehabilitation after TAR, and a general consensus is needed regarding weight-bearing status and walking boot use.

4.4 Data quality

Many of the sites had a very low number of superspells (only ten sites had >10 superspells) and so any patient outliers are likely to affect the mean for that site.

The authors acknowledge that the minimum LOS of 0 which was recorded for one site, suggests that surgeries were outpatient (although no outpatient spells were recorded under a separate HES heading), however the number of superspells at that site were very low. If this site is removed from the data, along with the site with LOS=17.3 (who also had a very low number of superspells) then, the mean observed LOS was 3.15 with a standard deviation of 1.9, and a minimum LOS of 1 and maximum of 9.9. This still shows a wide range of observed LOS of 8.9 days.

We initially also examined data on OPCS4 codes W441 (primary total prosthetic replacement of joint not using cement NEC), W451 (primary total prosthetic replacement of joint NEC), W541 (primary prosthetic replacement of articulation of bone NEC) and W531 (primary prosthetic replacement of articulation of bone not using cement NEC) but it was judged that the number of superspells under each heading was too low for the analysis to be meaningful.

4. CONCLUSION

We suggest that there is scope to improve the quality of efficiency of care if all trusts adopted ERAS principles for TAR surgery. The data suggest there is room for improvement in LOS, and the evidence from the two papers found in the literature search [24, 25] suggests that it can be feasible and safe to perform TAR as

outpatient surgery. However further evidence is needed to confirm whether LOS can be reduced through the introduction of ERAS to TAR surgery.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Stowers MD, Lemanu DP, Coleman B, Hill AG, Munro JT. Review Article: Perioperative care in enhanced recovery for total hip and knee arthroplasty. *J Orthop Surg (Hong Kong)* 2014;22:383-392.

2. Goldberg AJ, MacGregor A, Dawson J, Singh D, Cullen N, Sharp RJ et al. The demand incidence of symptomatic ankle osteoarthritis presenting to foot and ankle surgeons in the United Kingdom. *Foot* 2012;22:163-6.

3. Zaidi R, Cro S, Gurusamy K et al. The outcome of total ankle replacement. A systematic review and meta-analysis. *Bone Joint J* 2013;95-B:1500-7.

4. Easley, ME, Adams SB, Hembree WC, DeOrio JK. Results of total ankle arthroplasty. *J Bone Joint Surg* 2011;93:1455-1468.

5. Singh JA, Ramachandran R. Time trends in total ankle arthroplasty in the USA: a study of the National Inpatient Sample. *Clin Rheumatol* 2016;35:239-245.

6. Roukis TS, Prissel MA. Registry data trends of total ankle replacement use. *J Foot Ankle Surg* 2013;52:728-735.

7. National Joint Registry. 13th Annual Report. National Joint Registry for England, Wales, Northern Ireland and the Isle of Man. Surgical data to 31 December 2015. http://www.njrcentre.org.uk/njrcentre/Portals/0/Documents/England/Reports/3th%20Annual%20Report/07950%20NJR%20Annual%20Report%202016%20ONLINE%20REPORT.pdf [accessed 25.04.2107].

8. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth* 1997;78:606-17.

9. Gustafsson UO, Scott MJ, Schwenk W, Demartines N, Roulin D, Francis N et al. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg* 2013;37:259-284.

10. Lassen K, Coolsen M, Slim K et al. Guidelines for perioperative care for pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg* 2013;37:240-258.

11. Mortensen K, Nilsson M, Slim K, Schafer M, Mariette C, Braga M et al. Consensus guidelines for enhanced recovery after gastrectomy. Enhanced Recovery After Surgery (ERAS®) Society recommendations. *Br J Surg* 2014*;* 101, 1209-1229.

12. Ngren J, Thacker J, Carli F, Fearon KCH, Norderval S, Lobo DN et al. Guidelines for periperative care in elective rectal/pelvic surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg* 2013;37:285-305.

13. Husted H. Fast-track hip and knee arthroplasty: clinical and organizational aspects. *Acta Orthop*. 2012; 83,Suppl 346.

14. Ibrahim MS, Khan MA, Nizam I, Haddad FS. Peri-operative interventions producing better functional outcomes and enhanced recovery following total hip and knee arthroplasty: an evidence-based review. BMC Med. 2013;11:37.

15. Aasvang EK, Luna IE, Kehlet H. Challenges in postdischarge function and recovery: the case of fast-track hip and knee arthroplasty. *Br J Anaes* 2015;115: 861-6.

16. Malviya A, Martin K, Harper I, Muller SD, Emmerson KP, Partington PF et al. Enhanced recovery program for hip and knee replacement reduces death rate. *Acta Orthop* 2011;82:577-581.

17. Winther S B, Foss OA, Wik TS et al. 1-year follow-up of 920 hip and knee arthroplasty patients after implementing fast-track. *Acta Ortho*. 2015;86:78-85.

18. Aynardi M, Post Z, Ong A, Orozco F, Sukin DC. Outpatient surgery as a means of cost reduction in total hip arthroplasty: a case-control study. *HSSJ* 2014:10:252-5.

19. Berger RA, Sanders SA, Thill ES, Sporer SM, Valle CD. New anesthesia and rehabilitation protocols enable outpatient hip replacement in selected patients. *Clin Orthop Relat Res* 2009;467:1424-1430.

20. Berger RA, Kusama SK, Sanders SA, Thill E, Sporer S. The feasibility and perioperative complications of outpatient knee arthroplasty. *Clin Orthop Relat Res* 2009;467:1443-9.

21. Gromov K, Kjaersgaard-Andersen P, Revald P, Kelhlet K, Husted H. Feasiblity of outpatient total hip and knee arthroplasty in unselected patients. *Acta Orthop* 2017; http://doi.org/10.1080/17453674.2017.1314158.

22. Den Hartog YM, Mathijssen NMC, Vehmeijer SBW. Total hip arthroplasty in an outpatient setting in 27 selected patients. *Acta Orthop* 2015; 86, 667-670.

23. Dr Foster. https://da.drfoster.com; [accessed 05.07.17].

24. Gonzalez T, Fisk E, Chiodo C, Smith J, Bluman E. Economic analysis and patient satisfaction associated with outpatient total ankle arthroplasty. *Foot Ankle Int* 2017:38(5);507-513.

25. Mulligan RP, Parekh SG. Safety of outpatient total ankle arthroplasty vs traditional inpatient admission or overnight observation. *Foot Ankle Int* 2017;38(8)825-831.

26. Lord Carter of Coles. Operational productivity and performance in English NHS acute hospitals: Unwarranted variations. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/499229/Operational_productivity_A.pdf. February 2016 [accessed 10.10.17].

27. Getting it right first time (GIRFT) Programme. http://gettingitrightfirsttime.co.uk/ [accessed 10.10.17].

28. Jain NB, Pietrobon R, Guller U, Ahluwalia AS, Higgins LD. Influence of provider volume on length of stay, operating room time, and discharge status for rotator cuff repair. J Shoulder Elbow Surg 2005;14:407-13.

29. Weinheimer KT, Smuin DM, Dhawan AD. Patient outcomes as a function of shoulder surgeon volume: a systematic review. Arthroscopy 2017;33:1273-1281.

30. Young DS, Cota A, Chaytor,R. Continuous infragluteal sciatic nerve block for postoperative pain control after total ankle arthroplasty. *Foot Ankle Spec* 2014;7:271-6.

31. Gallardo J, Lagos L, Bastias C, Henriquez H, Carcuro G, Paleo M. Continuous popliteal block for postoperative analgesia in total ankle arthroplasty. *Foot Ankle Int* 2012;33:208-212.

32. DeOrio JK, Gadsden J. Total ankle arthroplasty and perioperative pain. *J Surg Orthop Adv* 2014;23:193-197.

33. Aydin D, Klit J, Jacobsen S, Troelsen A, Husted H. No major effects of preoperative education in patients undergoing hip or knee replacement – a systematic review. *Dan Med J* 2015:62:A5106.

34. McDonald S, Page MJ, Beringer K., Wasiak,J, Sprowson A. Preoperative education for hip and knee replacement. *Cochrane Database Syst Rev* 2014; Issue 5. Art. No: CD003526. ttp://doi.org/10.1002/14651858.CD003526.pub3.

Table Headings

Table 1: Definitions of outcome measures (Dr Foster[23])

Table 2: Search terms used in literature review

Table 3: Mean, Standard Deviation (SD), Minimum and Maximum Length of Stay