



Audit

Primary total knee replacement: a comparison of a nationally agreed guide to best practice and current surgical technique as determined by the North West Regional Arthroplasty Register

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Introduction: In 1999, a statement of best practice in primary total hip replacement was approved by the Council of the British Orthopaedic Association (BOA) and by the British Association for Surgery of the Knee (BASK) to provide a basis for regional and national auditable standards: we have compared practice in the North West of England to this document to ascertain adherence to this guide to best practice.

Materials and Methods: A direct comparison of data held on the North West Hip Arthroplasty Register for 2001/2002 and BASK/BOA guidelines was performed. 86 surgeons from 26 hospitals were included in the study.

Results: A mean of 93.3% of operations were performed in the surgeon's usual theatre. All of these theatres had vertical laminar air flow systems. 42.2% of respondents routinely used exhaust suits and 68.1% of respondents routinely used impermeable disposable gowns. All surgeons use some form of anti-thrombotic prophylaxis; 66.2% use a combination of both mechanical and chemical means. All surgeons used antibiotic prophylaxis. The most popular choice of antibiotic was a cephalosporin. 93.7% of surgeons routinely use antibiotic-loaded cement. The PFC and Kinemax prostheses were the most commonly used prostheses. Interestingly, 97.7% of all first-choice implants were cemented. Only 2 surgeons used uncemented total knee replacement. 69.8% of surgeons used a posterior cruciate retaining design. A midline longitudinal skin incision is used by 87.2% of surgeons, a medial longitudinal skin incision by 7.0% and a lateral longitudinal skin incision by 5.8% of surgeons. A medial parapatellar capsular incision is preferred by 91.9% with the remainder using mid vastus or trivector retaining capsulotomy. Closure of capsulotomies is performed in flexion by 65.1% and in extension by 34.9%. In patients with osteoarthritis, 38.4% routinely resurfaced the patella, 34.9% never resurfaced the patella and 26.7% selectively resurfaced. This was in direct contrast to practice for patients with rheumatoid arthritis in whom 66.3% routinely resurfaced the patella, 22.1% never resurfaced the patella and 11.6% selectively resurfaced.

Discussion and Conclusions: This study has demonstrated variation of practice in hip arthroplasty across the North West region and significant divergence from the BASK/BOA statement of best practice. The introduction of a properly funded national arthroplasty register will surely help to clarify the effect of such diverse practice on patient outcome.

Key words: Total knee arthroplasty – Register – Practice – Guidelines

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Primary total knee replacement is a highly effective way of reducing pain and improving function in patients with severe knee arthritis.^{1,6} Even though there are a large number of prosthesis to choose from, less than 50% of the implants have a 10-year follow-up or published results in peer-reviewed journals.² There is also a huge variation in the type of prosthesis used in different regions in the UK.³ Even though total hip replacement is more cost effective than total knee replacement,⁴ cost effectiveness of knee arthroplasty surgery compares favourably with other surgical interventions.⁵ National hip registers are well established in Sweden⁷ and Norway⁸ and have proven effective in identifying poorly performing prosthesis and surgical techniques. The need for maintaining a national arthroplasty register has been suggested⁹ and this is now in the process of being implemented.

In 1999, a statement of best practice in primary total knee replacement was approved by the Council of British Orthopaedic Association (BOA) and by the British Association for Surgery of the Knee (BASK).¹⁰ This document aims to describe the current best practice for primary total knee replacement. It identifies the fact that there is a shortfall of auditable standards for the operation and associated care and emphasises that standards can only be set by the wide-spread collection of uniform data centred on NHS trusts and made available for regional and national audit. It also applauds the recent moves towards setting up of a fully funded national knee replacement register.

The North West Arthroplasty Register (NWAR) was started with regional funding in 1992 by the senior author (MLP). At present, there are 30 hospitals included in this register. In December 1997, the 144 consultant orthopaedic surgeons in the North West were contacted by post with a standard surgical technique questionnaire (SSTQ). This questionnaire contained questions regarding the annual amount of primary and revision arthroplasty work carried out by each surgeon and their standard practice.

The aim of this study was to compare variations in current surgical techniques and postoperative care across the North West and compare this to the BOA/BASK guide to good practice.

Materials and Methods

Since 1997, a questionnaire regarding standard surgical technique has been sent to all orthopaedic consultants in the North West region as a part of the NWAR. It contains specific questions relating to theatre environment, surgical aspects and postoperative care for all joint arthroplasties. This detailed database is kept at Wrightington Hospital.

The BOA/BASK guide to good practice contains 17 sections on the subject of primary total knee replacement ranging from indications for surgery and surgical technique to long-term follow-up of patients. Sections 5 (pre-operative assessment), 8 (required theatre resources), 11 (choice of implant and mode of fixation), 12 (prophylaxis against venous thrombosis and pulmonary embolus), 13 (prophylaxis against infection), 14 (surgical technique) and 15 (early postoperative care) deal specifically with patient management. The data collected in 2002 were analysed according to the sections mentioned above in order to compare this to good practice. Results in variation are quoted as a percentage of the whole.

Results

For the year April 2001 to April 2002, 144 consultant orthopaedic surgeons were contacted with the SSTQ. Twelve surgeons were subsequently found to not be performing any primary joint arthroplasty and were, therefore, excluded. A total of 96 completed replies were received (a 72.2% response rate) of which 86 included details of primary total knee arthroplasty practice.

Demographics

The 86 replies were from a total of 26 hospitals across the North West region. The mean average number of years as a consultant of the responders as of 1 April 2002 was 8.2 years (median, 6 years; mode, 3). The mean number of primary total knee replacements performed per annum was 44.7 (mode, 50).

Required theatre resources

A mean of 93.3% (range, 50–100%) of operations were performed in the surgeon's usual theatre. All of these theatres had vertical laminar air flow systems. Of alternative theatres that were used, 75% had no laminar air flow systems. Of respondents, 31.3% routinely used Charnley hose-type exhaust suits and 11.3% used internally powered exhaust suits. Of respondents, 68.1% routinely used impermeable disposable gowns, 26.1% used impermeable re-usable gowns and 5.8% used neither. Overall, 14.1% solely use disposable drapes, 32.1% solely used impenetrable re-usable drapes, 51.3% use a combination of both and 2.5% use neither.

Choice of implant

Figure 1 documents first-choice prosthesis. The PFC and Kinemax prostheses were the most commonly used prostheses. Interestingly, 97.7% of all first-choice implants

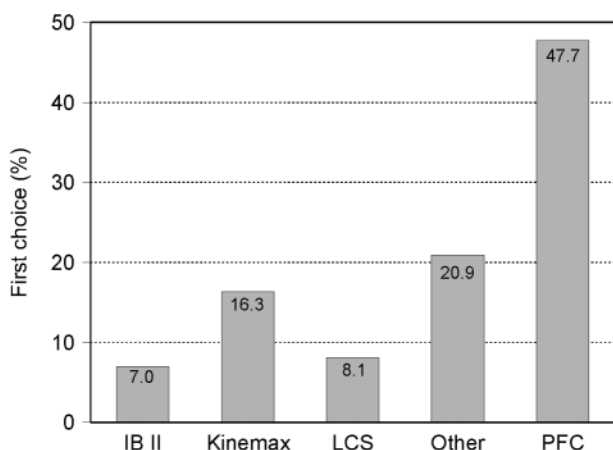


Figure 1 Percentage first-choice total knee replacement.

were cemented. Only 2 surgeons used uncemented total knee replacement. Of respondents, 69.8% of surgeons used a posterior cruciate retaining design. No details had been collected regarding the use of unicompartmental designs.

Thromboembolism prophylaxis

All surgeons use some form of prophylaxis to counter thromboembolic complications. The majority (66.2%) use a combination of mechanical and chemical means. Mechanical means only was favoured by 18.2% and solely chemical means by 15.6%. Figures 2 and 3 demonstrate variation in thromboprophylaxis regimens used by surgeons.

Prophylaxis against infection

Antibiotic prophylaxis was used by all surgeons. The most popular choice was a cephalosporin (88% routinely use Cefuroxime and 4% use Cephadrine); 4% used either Flucloxacillin or Co-amoxiclav. Only single antibiotic regimens were used. A three-dose regimen was the most popular (70.7%) followed by a single dose at induction (26.7%). Only 2.6% of surgeons continued antibiotic prophylaxis for 48 h after surgery and 94.2% of surgeons routinely use antibiotic-loaded cement.

Surgical technique

All surgeons routinely cleaned, irrigated and dried the femoral and tibial surfaces before cement insertion; 72.1% of surgeons used Palacos cement, 19.8% used CMW and 4.7% used Simplex.

A midline longitudinal skin incision was used by 87.2% of surgeons, a medial longitudinal skin incision by

7.0% and a lateral longitudinal skin incision by 5.8% of surgeons. A medial parapatellar capsular incision is preferred by 91.9% with the remainder using mid vastus or trivector retaining capsulotomy. Closure of capsulotomies is performed in flexion by 65.1% and in extension by 34.9%.

Figure 4 illustrates the number of drains routinely used by different surgeons.

In patients with osteoarthritis, 38.4% routinely resurfaced the patella, 34.9% never resurfaced the patella and 26.7% selectively resurfaced. This was in direct contrast to practice for patients with rheumatoid arthritis in whom 66.3% routinely resurfaced the patella, 22.1% never resurfaced the patella and 11.6% selectively resurfaced.

Early postoperative care

Figure 5 details the routine day to start knee flexion postoperatively.

Discussion

Reports of early failure of certain knee prostheses¹¹ have heightened professional, public and political awareness

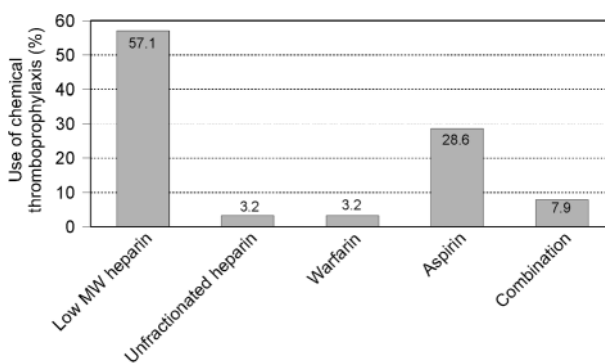


Figure 3 Percentage use of chemical thromboprophylaxis.

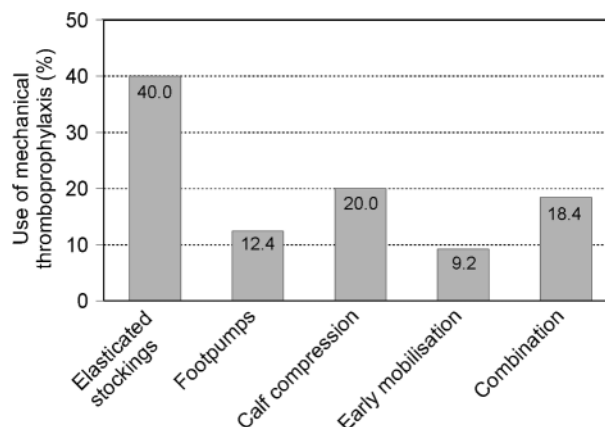


Figure 2 Percentage use of mechanical thromboprophylaxis.

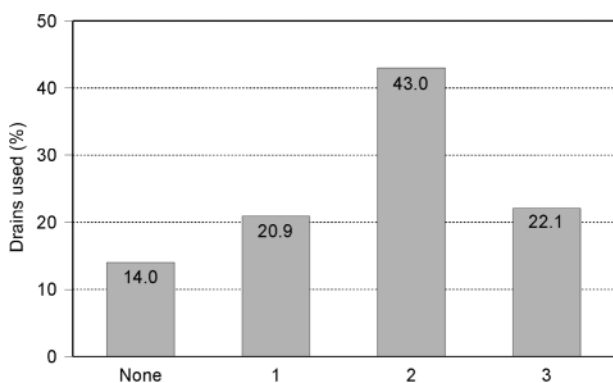


Figure 4 Percentage of number of drains used.

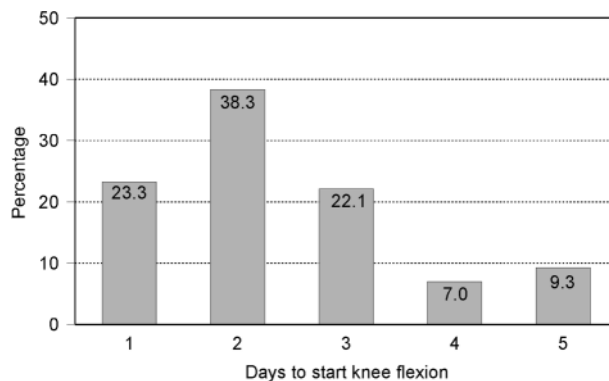


Figure 5 Number of days to start knee flexion.

of potential problems with total knee replacement. Attention has focused on improving surveillance of total knee replacement outcome and surgical practice. A recent Department of Health press release announced the placement of a contract to establish the National Joint Registry for Hip and Knee Replacements¹² which is now being implemented. Current surgical practice in the UK has only previously been reported on a regional basis¹³ and has not been compared to published best practice or has focused only on specific points of technique.¹⁴ This study is the first to compare regional data from a SSTQ with the BOA/BASK statement of best practice directly.

Required theatre resources

The use of ultra-clean-air theatres dedicated to clean, elective orthopaedic surgery is considered to be best practice as numerous authors have demonstrated their effect in reducing bacterial contamination and subsequent deep infection.^{15,16} Possibly due to historical reasons of the local development of such systems, all dedicated arthroplasty theatres had clean air flow and the vast majority of total knee replacements were performed in these theatres. A shared facility with other clean surgical disciplines is regarded as acceptable practice only if using ultra-clean air. We would highlight that three-quarters of operations performed in shared theatres had no clean air system available.

Impenetrable clothing and drapes, such as those of the disposable variety, are also essential as there is strong evidence to support their use as opposed to using permeable gowns.^{17,18} The vast majority of surgeons in our study routinely used such drapes.

Choice of implant

The BOA/BASK document recognises that many factors such as trainers, colleagues, manufacturers and perceived outcomes

of existing devices determine surgeon preference for an individual implant. Use of a knee prosthesis should normally be based on evidence published in peer-reviewed journals. A clinical follow-up of more than 10 years with a published life table and survivorship curve are recommended criteria in support of the use of a particular hip prosthesis. In the absence of such evidence, use must be subject to on-going surveillance and preferably as part of a controlled prospective trial.

Encouragingly, the majority of surgeons use knee prostheses with well-documented follow-up in peer-reviewed journals.^{19,20} Other less commonly used prostheses in the North West region should be subject to continued surveillance.²¹

Thromboembolism prophylaxis

Debate continues as to the actual incidence of this complication following total knee replacement because of varying methods of definition and detection.²² There is no good evidence to suggest that the use of chemical prophylaxis reduces either overall mortality or fatal pulmonary embolism. Strong evidence exists for the use of such prophylaxis in reducing the rate of occurrence of radiological venous thrombosis, but death from other causes may be increased.²³ Concern remains regarding possible bleeding complications. As such, the use of aspirin, heparin, low molecular weight heparin or warfarin is not considered mandatory in the guide to best practice. Early mobilisation and mechanical methods of prophylaxis are strongly recommended, even though scanty scientific evidence is available to support their use^{24,25} as they are generally free of side effects.

All surgeons in our study use some form of thromboembolic prophylaxis. Almost 20% rely solely on mechanical means. Given the doubt surrounding the benefit of chemical prophylaxis, its use is not considered mandatory.

Prophylaxis against infection

There are no specific data relating to total knee replacement so the BOA/BASK document suggests that results from studies in total hip arthroplasty can be extended to total knee replacement. A combination of systemic broad-spectrum antibiotics, gentamicin-impregnated cement, ultra-clean-air systems and ventilated suits are recommended as the most effective form of infection prophylaxis.¹⁰ Antibiotic prophylaxis is the single most important prophylactic measure²⁶ and it is re-assuring to find that all surgeons prescribe an antibiotic at induction with over 70% continuing doses at least 24 h after the operation as suggested by the BOA/BASK document. The vast majority use antibiotic-impregnated cement in addition. An exhaust suit system is used by 42.6% of surgeons; this is much higher than the 18% described in the results from The Royal College of Surgeons Total Hip Replacement Outcome Project.²⁷ This difference may be due to local influences and the development of the Charnley exhaust suit at Wrightington. Even though exhaust systems have been demonstrated to be effective in reducing infective complications in total hip arthroplasty surgery, 42.6% represents less than half of the number of surgeons who use the other methods of reducing deep infection. Whether this represents lacks a lack of comfort²⁸ when using such systems is not known.

Surgical technique

Any anterior incision which allows adequate exposure of the distal end of the femur, proximal end of the tibia and the posterior articular surface of the patella is deemed acceptable by the BOA/BASK document. All surgeons used such approaches with a midline longitudinal skin incision and medial parapatellar capsulotomy being the commonest approach used.

All surgeons routinely cleaned, irrigated and dried the femoral and tibial surfaces before cement insertion.

The issue of patellar resurfacing remains controversial as there are no strong data to support resurfacing or non-resurfacing and so surgeons fall into three groups: those who always resurface, those who never resurface and those who selectively resurface.^{29,30} The proportion who resurface increases when operating on rheumatoid patients probably due to the belief that leaving articular cartilage may risk a deterioration in symptoms in the future due to the inflammatory process.

Both the method of closure of the capsular incision, the use of drains are subject to continued debate in the orthopaedic literature^{31,32} and this is reflected in the variation in practise shown in our results as is the time to flexion postoperatively. The guidelines only state that

Table 1 Table detailing whether practise varies but is acceptable according to the joint guidelines in each section or diverges from the guidelines in certain individuals' practise as determined by the NWAR SSTQ

Section	Variation	Divergence
Theatre resources	Yes	Yes
Choice of implant	Yes	Yes
Thromboembolism prophylaxis	Yes	No
Infection prophylaxis	Yes	Yes
Surgical technique	Yes	No
Postoperative care	Yes	No

mobilisation, the achievement of full extension and an increasing flexion range should be supervised by a physiotherapist experienced in the management of patients following total knee replacement. Nearly 40% of patients do not start knee flexion until after 48 h which may be an overly conservative rehabilitation regimen that is still practised for historical reasons.

Conclusions

This study has demonstrated variation of practice in total knee replacement across the North West region and some divergence from the statement of best practice approved by the BOA and BASK. Many of the points of variation that have come to light in this study are merely matters of opinion and although there may be some scientific evidence to justify certain points, much is personal preference and prejudice rather than scientific fact. Table 1 lists specific points of divergence from the BASK/BOA document. The introduction of the national arthroplasty register will surely help to clarify the effect of such diverse practice on patient outcome. We would recommend that all trusts locally audit their practices and correlate them to these nationally agreed guidelines.

References

1. Heck DA, Robinson RL, Partridge CM, Lubitz RM, Freund DA. Patient outcomes after total knee replacement. *Clin Orthop* 1998; **356**: 93–110.
2. Liow RYL, Murray DW. Which primary total knee replacement. A review of currently available total knee replacement in the United Kingdom. *Ann R Coll Surg Engl* 1997; **79**: 335–40.
3. Newman K. Total hip and knee replacements – a survey of 261 hospitals in England. *J R Soc Med* 1993; **86**: 52–79.
4. Rissanen P, Aro S, Sintonen H, Asikainen K, Slati P, Paavolainen P. Costs and cost-effectiveness in hip and knee replacements. *Int J Technol Assess Health Care* 1997; **13**: 575–88.
5. Lavernia CJ, Guzman JF, Gachupin-Garcia A. Cost effectiveness and quality of life in knee arthroplasty. *Clin Orthop* 1997; **345**: 134–9.
6. Callahan CM, Drake BG, Heck DA, Dittus RS. Patient outcomes following tricompartmental total knee replacement. A meta-analysis. *JAMA* 1994; **271**: 1349–57.
7. Malchau H, Herberts P, Ahnfelt L. Prognosis of total hip replacement in Sweden. Follow-up of 92,675 operations performed 1978–1990. *Acta Orthop Scand* 1993; **64**: 497–506.

8. Havelin LJ, Espehaug B, Volset SE, Engesaeter LB. Early failures among 14009 cemented and 1326 uncemented prosthesis for primary coxarthrosis: The Norwegian Arthroplasty Register, 1987–92. *Acta Orthop Scand* 1994; **65**: 1–6.
9. Sochart DH, Long AJ, Porter ML. Joint responsibility: the need for a national arthroplasty register. *BMJ* 1996; **313**: 616–7.
10. British Orthopaedic Association. *Knee Replacement: A Guide to Good Practice* <www.boa.ac.uk>.
11. Liow RYL, Murray DW. Which primary total knee replacement. A review of currently available total knee replacement in the UK. *Ann R Coll Surg Engl* 1997; **79**: 335–40.
12. Department of Health. Health minister Lord Hunt announces successful contractor for the National Joint Registry <www.doh.gov.uk>.
13. Morris RW, Fitzpatrick R, Hajat S *et al*. Primary total hip replacement: variations in patient management in Oxford & Anglia, Trent, Yorkshire & Northern 'regions'. *Ann R Coll Surg Engl* 2001; **83**: 190–6.
14. Newman K. Total hip and knee replacements – a survey of 261 hospitals in England. *J R Soc Med* 1993; **86**: 52–79.
15. Charnley J. *Low Friction Arthroplasty of the Hip*. Berlin: Springer, 1979.
16. Lidwell OM, Lowbury EJJ, Whyte W *et al*. Effect of ultra clean air in operating rooms on deep sepsis in the joint after total hip or knee replacement: a randomised study. *BMJ* 1982; **285**: 10–14.
17. Ritter MA. Operating room environment. *Clin Orthop* 1999; **369**: 103–9.
18. Blomgren G, Horborn J, Nystrom B. Reduction of contamination at total hip replacement by special working clothes. *J Bone Joint Surg Br* 1990; **72**: 985–7.
19. Buechel FF, Pappas MJ. New Jersey Low Contact Stress Knee Replacement System. Ten-year evaluation of meniscal bearings. *Orthop Clin North Am* 1989; **20**: 147–77.
20. Fetzner GB, Callaghan JJ, Templeton JE *et al*. Posterior cruciate-retaining modular total knee arthroplasty: a 9- to 12-year follow-up investigation. *J Arthroplasty* 2002; **17**: 961–6.
21. Polyzoides AJ, Dendrinos GK, Tsakonas H. The Rotaglide total knee arthroplasty. Prosthesis design and early results. *J Arthroplasty* 1996; **11**: 453–9.
22. Salzman EW, Harris WH. Prevention of venous thromboembolism in orthopaedic patients. *J Bone Joint Surg Am* 1976; **58**: 903–13.
23. Freedman KB, Brookenthal KR, Fitzgerald RH *et al*. Thromboembolic prophylaxis in patients undergoing lower limb arthroplasty. *J Bone Joint Surg Am* 2000; **82**: 929–38.
24. Vanek VW. Meta-analysis of effectiveness of intermittent pneumatic compression devices with a comparison of thigh-high to knee-high sleeves. *Am Surg* 1998; **64**: 1050–8.
25. Sculco TP, Colwell CW, Pellegrini VD *et al*. Prophylaxis against venous thromboembolic disease in patients having a total hip or knee arthroplasty. *J Bone Joint Surg Am* 2002; **84**: 466–77.
26. Nasser S. Prevention and treatment of sepsis in total hip replacement surgery. *Orthop Clin North Am* 1992; **23**: 265–77.
27. Best AJ, Fender D, Harper WM, McCaskie AW, Oliver K, Gregg PJ. Current practice in primary total hip replacement: results from the National Hip Replacement Outcome Project. *Ann R Coll Surg Engl* 1998; **80**: 350–5.
28. Whyte W, Bailey P, Hamblen DL *et al*. A bacteriologically occlusive clothing system for use in the operating room. *J Bone Joint Surg Br* 1983; **65**: 502–6.
29. Keblish PA, Varma AK, Greenwald AS. Patellar resurfacing or retention in total knee arthroplasty. A prospective study of patients with bilateral replacements. *J Bone Joint Surg Br* 1994; **76**: 930–7.
30. Bourne RB, Rorabec CH, Vaz M *et al*. Resurfacing versus not resurfacing the patella during total knee replacement. *Clin Orthop* 1995; **321**: 156–61.
31. Masri BA, Laskin RS, Windsor RE, Haas SB. Knee closure in total knee replacement: a randomised prospective trial. *Clin Orthop* 1996; **331**: 81–6.
32. Esler CN, Blakeway C, Fiddian NJ. The use of a closed-suction drain in total knee arthroplasty. A prospective, randomised trial. *J Bone Joint Surg Br* 2003; **85**: 215–7.