Cementation technique for elbow arthroplasty; an international survey

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A B S T R A C T

Background: Modern cementation techniques have markedly improved survivorship in lower limb arthroplasty, which have been heavily researched in the hip and knee but less so for upper limb procedures. Aseptic loosening is a leading cause of failure in total elbow arthroplasty (TEA) which could be related to the quality of cementation. The aim of this study was to investigate the cementation techniques used for TEA among practicing elbow surgeons.
Methods: An electronic questionnaire was emailed to members of the British elbow and shoulder society (BESS) and PubMed identified experts. Questions focused on the type of prosthesis, operative rates for elective and trauma cases, nature of cement used, canal preparation and cement insertion. Opinions regarding satisfaction with current techniques and mantle quality were also collected.
Results: A total of 26 surgeons completed the questionnaire. The Coonrad-Moorey was the most popular device amongst respondents. Most cemented both components, used antibiotic loaded cement, washed the canal with saline and inserted the cement retrograde. There was wide variation in cementation techniques used for the humerus and ulna, particularly regarding cement preparation, insertion, and use of a restrictor and pressurisation.
Conclusion: Modern cementation techniques are not being utilised in TEA which could be contributing to implant loosening rates and longevity.

1. Introduction

Modern cementation techniques (MCTs) have undergone a major revolution; from so called first generation techniques introduced in the middle of the last century which left bone unprepared, to the more recently popularised third generation techniques of diligent bone and cement preparation in addition to pressurisation.[1–3] These techniques have been well studied in lower limb arthroplasty resulting in great improvements in prosthesis design, surgical technique and implant longevity[4–7]; however, such techniques are less rehearsed in upper limb arthroplasty.[8,9] A total of 508 total elbow arthroplasties (TEA) were recorded in the national joint registry (NJR) of the United Kingdom (UK) in 2013.[10] Of these, 22% were revisions; with over 56% of these occurring as a result of aseptic loosening.[10] Loosening is one of the major limitations of TEA, especially in high demand arthritic patients.[11–15] Traditionally biomechanical factors have been proposed as

the main cause of aseptic loosening in TEA; however, cementation techniques may also play a role. The purpose of this study was to investigate the current trends in elbow cementation techniques amongst orthopaedic surgeons.

2. Methods

A questionnaire was created which explored the demographics and cementation techniques of orthopaedic specialists, including; the number and type of TEA performed per year for both elective and acute traumatic conditions, preference of cemented or cementless implants, type of cement used and details of cementation technique. The responder's personal views regarding the scope of improvement in TEA cementation, whether the longevity of their implant is related to the technique and overall satisfaction rates with cement mantle quality was also collected. The questionnaire was disseminated electronically via
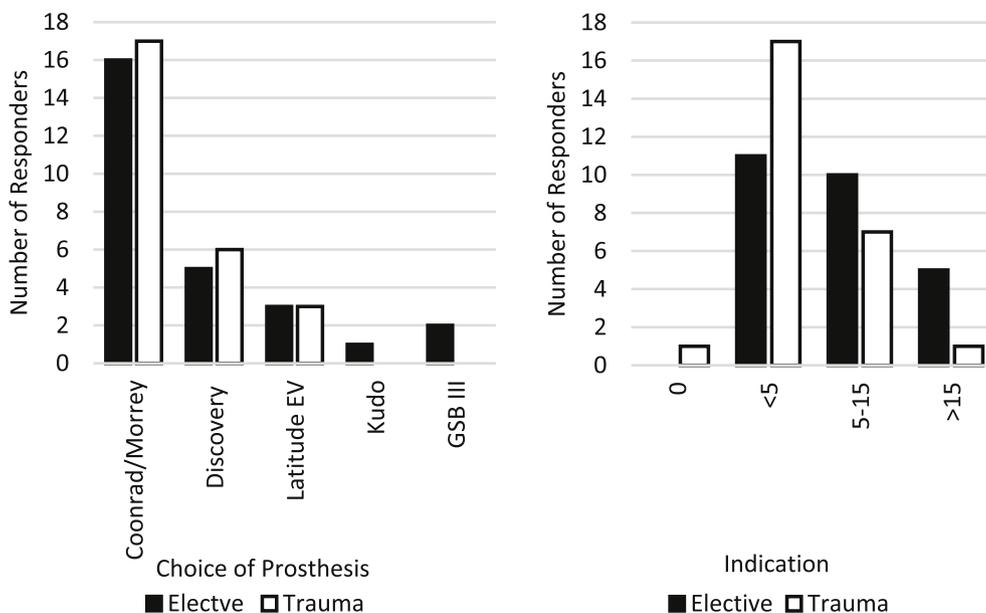
Fig. 1. Most frequently used prosthesis and the number of TEA procedures undertaken per year for traumatic and nontraumatic indications among responders.

the Survey Monkey internet tool to members of the British Society of Shoulder and Elbow Surgeons (BESS). In addition, a search of the PubMed was undertaken (from the year of its creation to May 2016) using combinations of the following search terms: total elbow arthroplasty, total elbow replacement, cementation, cement, techniques. A total of 37 highly published corresponding and senior authors of case series, technical notes, reviews and primary research pertaining to TEA were identified and emailed the questionnaire.

3. Results

The questionnaire was completed by 17 responders from BESS and 9 (24%) international experts identified via the literature search. Most respondents performed 5-15 TEA per year, with trauma as the most common indication and the Coonrad-Moorey as the most popular device for both elective and trauma cases (Fig. 1). All responders cemented both humeral and ulna components, and 85% of responders used antibiotic loaded cement.

All responders washed the canal with saline; 92% did not use a brush to clean the bony surfaces prior to cementation, however most responders (58%) used dry gauze to dry the canal (Fig. 2). The majority (62%) did not use a restrictor for ulna cementation but did so for the humerus (77%); with most preferring an artificial plug (Fig. 3). Most responders (79%) preferred retrograde cement insertion into the humerus, while only 48% did this for cementation of the ulna (Fig. 3). Most did not place cement on the tip of the humeral (92%) or ulna (88%) component prior to insertion. Pressurisation of the ulna was performed manually by 68% and 60% repeated this for the humerus
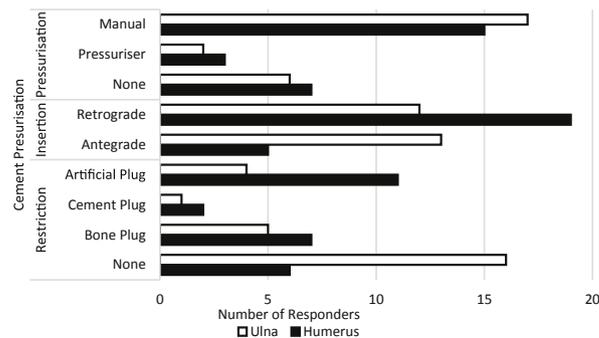

Fig. 2. Methods of canal preparation favoured by responders.

Fig. 3. Methods of cement pressurisation favoured by responders.
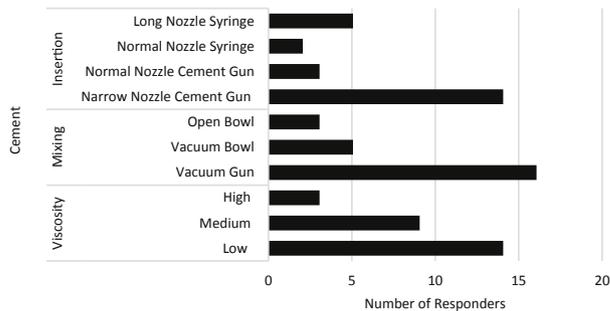
Fig. 4. Type of cement used, methods of cement preparation and insertion favoured by responders.

(Fig. 3). Low viscosity cement was the most common (54%), gun vacuum mixing was used by 67% and 56% used a narrow nozzle gun during humeral cementation (Fig. 4).

Almost all responders (92%) felt that further research and innovation was needed in cementation techniques for elbow arthroplasty and most (63%) felt these were directly related to implant longevity. Most were moderately satisfied with mantle quality after TEA (Fig. 5).

Fig. 5. Satisfaction among responders pertaining to current cementation techniques in TEA and quality of cement mantle achieved on average.

4. Discussion

In the period from 2012 to 2014, the UK NJR reported 1,085 primary and 359 revision (33%) TEAs; compared to over 89,900 (11% revisions) THR and over 91,700 (6% revisions) TKR undertaken in 2013 alone.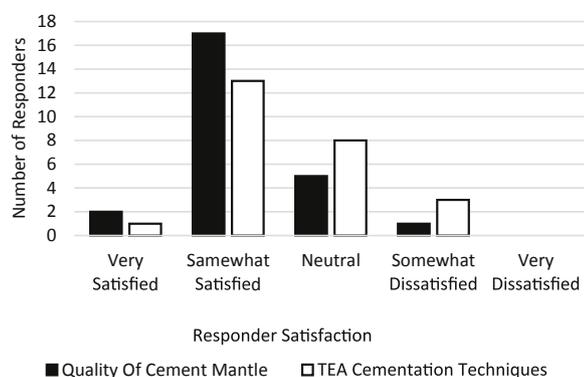[10] Traditional indications for TEA include trauma and inflammatory arthropathy but it is increasingly used in primary osteoarthritis, acute fracture and non-union, instability and reconstruction.[16–19] TEA implant survivorship is 13% and complications rates are high, occurring in 43% in some reports.[20] They include infection, periprosthetic fracture and triceps insufficiency.[16] The most common complication is aseptic loosening which leads to revision rates of 13–19%.[21,22] Few studies have investigated the reasons for this disparity and multiple factors may hinder such research and advances in surgical technique. For example, TEA outcome data is rarely reported in national registries and most large scale reviews are produced by institutions from where the prosthesis originated.[20,21] The heterogeneity and frequent alterations of implant design,[23] regional anatomy and biomechanics[16] and lack of surgical experience may all play a role in poor outcome.[24] Patient characteristics also influence survivorship, with elbow implants typically lasting longer in rheumatoid patients due to their low demand and protective characteristics when compared to younger, more active patients.[11–13]

MCTs improve the micro-interlock and resistance to sheer stress at the cement bone interface.[12,14] First generation methods involved cementation without bone preparation and minimal, nonrestricted pressurisation of hand mixed cement. Second generation methods saw the advent of canal brushing and the advocated use of cement restriction which resulted in decreased loosening rates of the femoral component.[6,7,15] Pulsatile lavage, retrograde insertion of diligently prepared cement and the use of polished stems were then added to create third generation methods.[1,4,5,7,25] The newest developments include the addition of both distal and proximal centralisers for optimum implant alignment and equal cement distribution.[26] MCTs have proved effective as demonstrated by significant improvements in loosening rates and survivorship of lower limb implants as a result of their widespread use.[3,27–31] Retrograde cement insertion and restrictor application results in higher pressures during cementation which in turn improved cement bone interlock.[3,32–34] Pulsatile lavage, which is more effective at clearing debris when compared to low pressure systems,[35,36] followed by drying has also been shown to improve interlock.[1,2]

A third of TEA revisions are related to aseptic loosening.[20] Our results indicate that MCTs are not utilised in TEA despite evidence to support their efficacy.[8,20] This may be due to the technical challenges in TEA, lack of appropriate equipment or the lack of appreciation for the importance of cement techniques in upper limb arthroplasty. Retrograde cementation in vivo[20] as well as pressurisation and the use of a

restrictive device in vitro[8] produce higher quality cement mantle, however regional anatomy and poor bone quality increase the risk of intraoperative fracture and necrosis,[37] making these techniques difficult to perform intraoperatively. This is demonstrated by our results which show marked differences in the cementation techniques used for the components of the prosthesis. Most responders did not utilise a restrictor and inserted cement antegrade in the ulna while the opposite was found for the humerus which may be related to canal or component size. Difficulty in restrictor placement was noted in a study by Danter et al.[9] They used MCTs for canal preparation in 16 humeri and radiographed them after restrictor placement, after cementation and after stem insertion. A proximal migration and leakage rate of 62.5 and 37.5% with current restrictive devices was noted however there was an improvement in cement mantle despite this. The researchers postulated that the funnel shaped humerus, made positioning a restrictor difficult but no such study has been undertaken in the ulna. Smith et al. studied the cement mantle quality obtained with the use of a narrow nozzle gun versus that produced by syringe inserted cement in 12 cadaveric humeri. Gun inserted cement produced a superior cement mantle despite the absence of a restrictive device for canal occlusion.[38]

Prosthesis design may also be related to poor cementation and high loosening rates especially in linked designs, while unlinked implants are more prone to metallosis, instability and polyethylene wear.[39] The large sized ulna component is difficult to cement and coronoid impingement on the anterior humerus creates distraction forces between the ulna and its component[20] and is the reason why cemented prosthesis are preferred by most surgeons.[40] Sloppy hinge devices are more susceptible to polyethylene wear osteolysis[12] and linked devices have a longer survivorship than unlinked devices.[20] All these areas have yet to be fully researched but could play an important role in the future of total elbow arthroplasty.

The limitation of this study was the response rate; however, this is understandable given that very few surgeons undertake TEA and over all rates are a fraction of those for lower limb arthroplasty.[10] It was also impossible to know the number of potential participants who received the questionnaire and to calculate response rate given the blinded method of questionnaire distribution. Nevertheless, there is no gold standardized response rate that would alter the accuracy of such data.[41–43]

5. Conclusion

Our results suggest that new cementation techniques are not being utilised in TEA. This could be contributing to the high loosening rates associated with the procedure, however it has yet to be demonstrated in clinical studies. Cadaveric studies have added to the understanding of cementation around the elbow, however further research is needed into optimum cementation methods for TEA.

Conflicts of interest

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

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