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Review

The efficacy of the tourniquet in foot and ankle surgery? A systematic review and meta-analysis☆,☆☆

T.O. Smith MSc, BSc (Hons) MCSP[a,*], C.B. Hing BSc, MSc, MD, FRCS (Tr&Orth)[b]

[a] Institute of Orthopaedics, Norfolk & Norwich University Hospital, Colney Lane, Norwich, Norfolk NR2 7UY, UK
[b] Watford General Hospital, Watford, UK

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ABSTRACT

Tourniquets are commonly used during foot and ankle surgery. The purpose of this study was to compare the peri- and post-operative outcomes of tourniquet-assisted to non-tourniquet-assisted ankle and foot surgery. A systematic review was undertaken assessing the electronic databases Medline, CINAHL, AMED and EMBASE, in addition to a review of unpublished material and a hand search of pertinent orthopaedic journals. The evidence-base was critically appraised using the Cochrane Bone, Joint and Muscle Trauma Group quality assessment tool. Study heterogeneity was measured using χ^2 and I^2 statistics. Where appropriate, a random-effects meta-analysis was undertaken to pool results of primary studies, assessing mean difference or relative risk of each outcome. A total of four studies were identified. The findings of this study would suggest that hospital length of stay was significantly shorter, and that the post-operative period was less painful, with reduced swelling from the fifth post-operative day, in surgeries undertaken without a tourniquet, compared to tourniquet-assisted procedures. There may be a greater incidence of wound infection and deep vein thrombosis in tourniquet-assisted foot and ankle procedures. The methodological quality of the evidence base is limited. Further study is required to address these limitations, after which we may be able to determine whether a tourniquet should be used during ankle or foot procedures.

Contents

☆ Study conducted at Norfolk & Norwich University Hospital, London, UK.
☆☆ Each author certifies that he has no commercial associations.

* Corresponding author. Tel.: +44 01603 286595.
E-mail address: toby.smith@nnuh.nhs.uk (T.O. Smith).

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1. Introduction

Tourniquets are commonly employed during foot and ankle surgery [1,2]. The objective of a tourniquet is to optimise surgical field visualisation, thereby limiting operative duration and improving technical precision [1–6]. However, adverse events associated with the application of tourniquets during lower limb surgery include neuropraxia [7,8], vascular injury [9,10], post-operative swelling and joint stiffness [11–13], hyperemia on tourniquet deflation, increased post-operative pain [12,14–17], decreased muscle endurance and functional weakness [12,18–21]. An increased incidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) have also been associated with tourniquet use [7,22–27]. Furthermore, a fluctuation in the cardiovascular system has been reported, which may cause intra-operative cardiac arrest [12,13,28–30].

Some confusion exists as to whether tourniquets should routinely be used during ankle or foot surgery. This may be attributed to a paucity of clearly defined guidelines and consensus statements on this topic. In response to this, the purpose of this study is to compare the peri- and post-operative outcomes of foot and ankle surgery with and without a tourniquet.

2. Methodology

2.1. Search criteria

All full text randomised and non-randomised controlled trials, comparing the clinical outcomes of orthopaedic surgery using, and not using a tourniquet during surgery in published and unpublished studies were included. Participants aged 16 years or older of either gender were eligible for inclusion. Case reports of less than five subjects, comments, letters, editorials, protocols, guidelines, animal and cadaver articles were excluded. Language restrictions were not imposed.

2.2. Search strategy

An electronic database search was undertaken using Medline (1950 to December 2008), CINAHL (1982 to December 2008), AMED (1985 to December 2008) and EMBASE (1974 to December 2008), searched via Ovid using the MeSH terms and Boolean operators: tourniquet AND leg. The Cochrane library was also searched with the search term 'tourniquet'. By including studies dated from 1974, some surgical interventions may not have reflected current clinical practice. However, this broad eligibility criterion was deemed appropriate in order to prevent the exclusion of any published data on this topic for a comprehensive systematic review. Unpublished or grey literature was identified using the databases SIGLE (System for Information on Grey Literature in Europe), the National Technical Information Service, the National Research Register (UK), UKCRN Portfolio Database, and Current Controlled Trials database. The reference lists of all included articles and review papers were scrutinised for additional publications. The corresponding authors of each paper which adhered to the selection criteria were contacted to enquire about any additional articles not previously identified.

2.3. Search selection

CH and TS independently assessed the titles and abstracts of each identified citation. The full text of potential articles were ordered and evaluated against the eligibility criteria. Any disagreements were resolved by discussion.

2.4. Data extraction

Each reviewer (TS, CH) extracted data independently from each included paper. All data was tabulated onto a predefined spreadsheet. All articles were anonymised for author name, institution, journal title and year of publication to blind reviewers during data extraction, appraisal and analysis.

2.5. Outcome measures

The primary outcome measure was intra-operative surgical difficulty due to poor visualisation of the surgical field. Secondary outcomes measures were intra-operative blood loss, post-operative blood loss, operative time, pain, range of motion, muscle strength and complications including incidence of DVT, PE, neurological impairment and wound healing disorders.

2.6. Data analysis and appraisal

CH and TS independently evaluated the methodological quality of full texts included in this review using the Cochrane Bone, Joint and Muscle Trauma Group quality assessment tool [31]. This is an appraisal tool which has been specifically designed to assess the methodological quality of randomised controlled trials and has been used on previous meta-analyses [32,33]. Any disagreements were resolved by discussion until a consensus was met.

2.7. Analysis

The mean difference of each outcome was assessed comparing tourniquet and non-tourniquet groups. Where appropriate, relative risk was evaluated. Two publications did not provide sufficient data to undertake meta-analysis. For these studies, corresponding authors were contacted in an attempt to obtain this missing data.

Statistical heterogeneity was measured using χ^2 and I^2 statistics. We used a random-effects meta-analysis to pool results of the primary studies when judged appropriate. Meta-analysis was carried out using REVMAN software (version 5.0 for Windows. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2008).

3. Results

3.1. Search strategy

Of the initial 849 citations identified, 4 specifically compared intra- and post-operative outcomes of ankle or foot surgery performed with or without a tourniquet [34–37] (Fig. 1, Table 1). Three articles assessed the effects of tourniquet with open reduction internal fixation of ankle fractures [34–36]. One study assessed tourniquet application during foot surgery [37].

3.2. Primary outcome measure

Technical difficult through poor visualising of the surgical field was not assessed in any study identified.