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## Air travel and thromboembolic events after orthopedic surgery: Where are we and where do we need to go?

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### ABSTRACT

**Introduction:** As medical tourism expands, guidelines must be established to allow for appropriate patient counseling, as there is already an inherent increased venous thromboembolism risk with air travel. We review orthopedic literature to determine if there are post-operative air travel recommendations that can be made and where additional focus should be directed that may decrease thromboembolic complication rates in this already at-risk population.

**Methods:** A systematic review of the Medline and Cochrane databases was conducted for articles related to air-travel and orthopaedics. As joint arthroplasty research focuses heavily on venous thromboembolisms and their prevention, we initially directed our review to this field using the search terms- “thromboembolism OR flight OR flying AND arthroplasty”. Criteria for inclusion were abstracts and articles related to the topic of venous thromboembolism in orthopaedic procedures, which were relevant to the study question. A meta-analysis for risk estimation of thromboembolism was to be conducted.

**Results:** The query identified 1542 studies. 6 articles were assessed for eligibility, 2 proved to be relevant. None of the studies were prospective or randomized.

**Conclusion:** Due to the small sample and heterogeneity of the studies available, a meta-analysis could not be performed. Acute post-operative air travel appears safe following joint arthroplasties and upper extremity fractures, but is unclear for spine and trauma patients. Further research should be directed towards the growing trend of air travel following surgical procedures.

### 1. Introduction

While the association between venous thromboembolism (VTE) and air travel has been well established (Cannegieter et al., 2006; Cesarone et al., 2002; Chandra et al., 2009; Clarke et al., 2006), the risk of VTE associated with air travel following an orthopedic procedure has seldom been investigated. The elective nature of many orthopaedic procedures allows patients to travel significant distances by air for consultation and intervention. Physician prominence and reputation represents a major reason for medical tourism (Alleman et al., 2011; Hanefeld et al., 2015; Kumar et al., 2012; Turner, 2010). Costs may also be a factor when patients are considering undergoing arthroplasty as regional variation of costs exist and have previously demonstrated in the literature (Cram et al., 2015; Kumar et al., 2012; Li et al., 2013). Also, certain patients may elect to undergo joint replacement at centers where family

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members or friends have received satisfactory outcomes, even if it requires them to fly from their location of residence (Kovacs et al., 2014). A frequent question in this patient population pertains to when it is medically 'safe' to fly on a plane to return home. Similarly, many orthopedic trauma patients are injured far from their primary residence and frequently inquire about the safety of post-operative air travel home. Given the rise of medical tourism globally; an understanding of the risk of VTE with air travel following orthopaedic surgery, is essential for health care professionals to provide appropriate patient counseling and care.

In 2014, Cooper et al. published a retrospective cohort analysis of patients flying after an elective total joint arthroplasty, on average 2.9 days post-operative. They did not show an association between early air travel and VTE (Cooper et al., 2014). However, they noted a small cohort limited their power to detect a rare postoperative complication. Given the many factors that may cause a patient to fly after an orthopedic surgery, it is imperative to examine the current evidence to determine what prophylactic measures can be taken to reduce the risk of VTE and air travel to baseline.

The purpose of this study is to provide the reader with a descriptive, thorough review of the current evidence regarding air travel following orthopedic procedures. Our secondary objective was to determine which areas of orthopedic care require further investigation to facilitate the creation of guidelines. We initially focused on air travel and total joint arthroplasties due to its surge in medical tourism (Turner, 2010) as well as its historically well researched association with VTEs and post-operative protocols.

## 2. Materials and methods

We performed a systematic review of the published literature on VTE, air travel and orthopaedics using MEDLINE and Cochrane Library, without date restrictions up to September 2016 following the PRISMA guidelines on systematic reviews. The search terms defined for the purpose of this study was "thromboembolism OR flight OR flying AND arthroplasty". Subgroup analysis was performed according to subspecialty area of orthopaedics. We initially identified 1453 articles, yet only 6 articles met the inclusion criteria. The inclusion criteria was: articles level of evidence I-V, available in the English language, published within the last 10 years, covering the topic of DVT/PE after orthopedic procedures, relating to the study of the effects of flight after orthopedic procedures. Conclusions were drawn on the incidence (symptomatic and asymptomatic VTE), pre VTE intervention (conservative management vs surgery), associated risk factors, and the use of mechanical and pharmacological prophylaxis.

## 3. Results

Our query initially identified 1542 studies. Of the 6 articles assessed for eligibility (Clarke et al., 2006, 2016; Cooper et al., 2014; Gajic et al., 2005; Tormes and Webster, 2002), only 2 proved to be relevant to our research question (Cooper et al., 2014; Tormes and Webster, 2002).

The reasons for discarding the 4 other articles are the following: One article by Gajic et al. examined long-haul air travel *before* major surgery and its effects on DVT incidence (Gajic et al., 2005). No evaluation of the effects of flight after surgery was performed and thus did not relate to our study. Furthermore, of the patients who had flown in over 5000 miles for the procedure and developed a DVT, none had undergone orthopedic procedures. The article by Nwachukwu et al. was also excluded, as it did not allow for stratification of the long distance traveled (flight versus driving) after TJA or orthopedic procedures (Nwachukwu et al., 2015) (Fig. 1).

The two other articles excluded were articles found in the Cochrane database and were systematic reviews and meta-analysis of

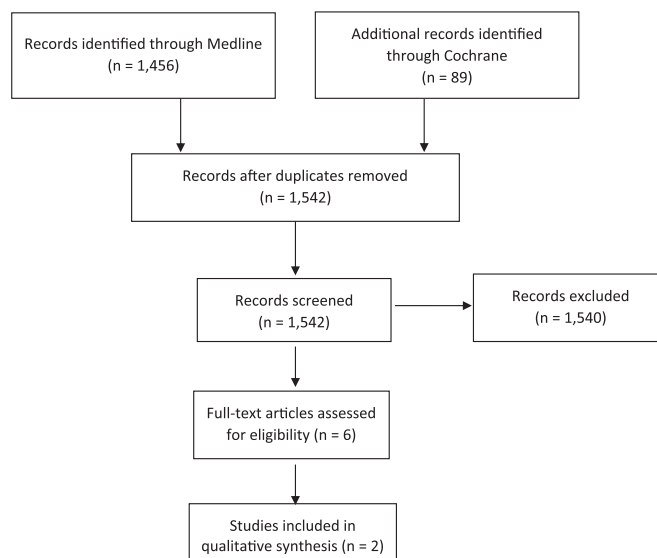


Fig. 1. Summary of the Literature Review.

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