Effectiveness of prehabilitation for patients undergoing orthopaedic surgery: protocol for a systematic review and meta-analysis

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ABSTRACT

Introduction Undergoing major surgery can induce physical and functional decline. Prehabilitation programmes aim to improve physical fitness and function preoperatively and could enhance postoperative recovery and outcomes. Prehabilitation interventions have been utilised across a range of orthopaedic populations of all ages and can be multimodal in nature. The aim of this study is to evaluate the effectiveness of prehabilitation for patients undergoing orthopaedic surgery including day surgery procedures. It will also investigate the components of prehabilitation to understand optimum duration and frequency of programmes.

Methods/design Systematic review and meta-analysis designed in accordance with Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols. A comprehensive electronic search will be performed in MEDLINE, CINAHL, AMED, Embase, PEDro and Cochrane CENTRAL databases in order to identify randomised control trials published between January 2000 to 25 March 2019. ISI Web of Science, System for information on grey literature and the European Union clinical trials registry will identify studies that are underway or unpublished. Two independent reviewers will carry out the searches, study selection (title and abstract and full text stages), data extraction, risk of bias assessment (Cochrane Risk of Bias tool 2.0) and evaluation of overall strength of evidence. Meta-analyses will be used for data which demonstrates homogeneity, otherwise a narrative synthesis will be performed for groups of studies of high heterogeneity (I^2 >50%). The overall strength of the body of evidence will be assessed using Grading of Recommendations Assessment, Development and Evaluation.

Ethics and dissemination This study raises no ethical issues. This study aims to identify the effectiveness of prehabilitation interventions and may assist clinicians in determining which components, duration, frequency and the method of delivery would form the most effective prehabilitation intervention for patients undergoing an orthopaedic surgical procedure. The findings will be disseminated through publication in a peer-reviewed journal and conference presentations.

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INTRODUCTION

More than 8 million surgical procedures are performed in the UK each year. With an increase in the ageing population, it is anticipated that more surgical procedures will be performed in the future. Major surgery can induce pain, increase catabolism and oxygen demand that could lead to postoperative complications and deconditioning resulting in a decline of one’s physical function. In order to withstand the stressor of inactivity following a surgical procedure, a period of prehabilitation prior to surgery may be beneficial in optimising physical and functional capacity in these patients. It is evident from the literature that individuals with limited physical fitness preoperatively have higher morbidity and mortality whereas individuals with better physical fitness are expected to have better postoperative outcomes.

The concept of prehabilitation was first mentioned in the literature in 1946. The authors reported how a period of physical and educational training along with nutritional support improved the physical and mental well-being of army recruits during the second world war. However, it was not until early 2000, that researchers began to investigate the role of prehabilitation in improving
postoperative outcomes. Since then several trials have been conducted to evaluate the benefits of prehabilitation in patients undergoing various surgical procedures ranging from cardiovascular to orthopaedics. Prehabilitation interventions have been utilised across all age groups and also in sports medicine as a tool to reduce the risk of sporting injuries. Although exercises are considered a key component in prehabilitation, the concept of prehabilitation interventions has evolved over the years becoming multimodal in nature. Interventions typically include exercise, nutrition, medical optimisation and psychological support delivered by a multidisciplinary team.

A number of good quality systematic reviews have been published recently investigating the benefits of prehabilitation within orthopaedics, but with varying conclusions. Cabilan et al explored the effects of prehabilitation in all surgical patients including orthopaedics, cardiac and abdominal surgeries. The review found no significant benefit in postoperative function, pain and quality of life in patients who had joint arthroplasty for osteoarthritis, although there was some evidence that prehabilitation doses of >500 min might reduce acute rehabilitation admissions (OR 0.51, 95% CI 0.28 to 0.93). However, when participants who had undergone either a total hip or total knee replacement were grouped together, this was no longer significant. This review also reported that there was limited evidence on other surgical populations to derive any firm conclusions. The review had excluded day surgery patients and therefore has its limitations as there is a strong recent drive towards enhanced recovery programmes and more joint arthroplasties being performed as day cases.

Additionally, the review only included trials published before March 2013. Wang et al conducted a systematic review and meta-analysis on the effectiveness of prehabilitation for patients undergoing total hip arthroplasties (THA) and total knee arthroplasties (TKA) and reported slight improvement in: early postoperative pain (at 4 weeks), weighted mean difference −6.1 points, (95% CI −10.6 to −1.6 points) on the Visual Analogue Scale; function measured using the Western Ontario and McMaster Universities Arthritis Index (WOMAC) function score at 6 to 8 weeks −8.1, (95% CI −7.5 to −8.5); time to climbing stairs −1.4 days, (95% CI −1.9 to −0.8 days); toilet use −0.9 days, (95% CI −1.3 to −0.5 days) and chair use −1.2 days, (95% CI −1.7 to −0.8 days). However, the authors concluded that effects were too small and in the short-term to be considered clinically significant.

A more recent review by Moyer et al evaluated the benefits of prehabilitation in patients undergoing THA and TKA and reported significant improvements in quadriceps strength, pain, function and length of stay which contradicted previous reviews. Patients undergoing THA, had significantly less postoperative pain than controls (standard mean difference (SMD)=0.15, 95% CI 0.03 to 0.27, p=0.017). Postoperative function was also significantly improved compared with controls (THA SMD=0.32, 95% CI 0.15 to 0.50, p<0.001; TKA SMD=0.39, 95% CI 0.06 to 0.57, p=0.015). Significantly greater quadriceps strength was observed after TKA (SMD=0.42, 95% CI 0.16 to 0.68, p=0.002). Length of stay was significantly shorter after TKA (SMD=0.54, 95% CI 0.24 to 0.84, p<0.001) and THA (p=0.027). This review included 35 studies which explored both preoperative exercises and patient education that may have had some influence on the positive results compared with previous reviews.

Previous reviews within the orthopaedic literature have mainly focused on the effectiveness of physical exercise, and on patients undergoing joint replacements rather than on arthroscopies or other day surgery procedures. Prehabilitation, in recent years has also become much broader encompassing multimodal interventions such as patient education and counselling, nutritional support and physical exercises. There is also limited evidence in the literature as to the most effective prehabilitation intervention and what components or combination of components, duration and frequency of prehabilitation intervention might be more effective. Therefore, the purpose of this study is to conduct an up to date, comprehensive systematic review and meta-analysis to explore the benefits of prehabilitation on postoperative outcomes for patients undergoing all types of orthopaedic surgical procedures including day case surgeries. This review will also encompass trials which utilised multimodal interventions in their prehabilitation programme.

Objectives
The primary objective is to synthesise the evidence on the effectiveness of prehabilitation in improving postoperative outcomes for patients undergoing orthopaedic surgery. Secondary objectives are to explore the core components of prehabilitation and whether there is evidence of an optimum duration and frequency that a patient needs to undergo prehabilitation in order to achieve better outcomes.

METHODS
We plan to conduct a systematic review of the literature according to a predefined protocol which complies with recommendations from the Cochrane Collaboration Musculoskeletal group and Centre of Reviews and Dissemination guidelines and designed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-P) guidelines and will be reported using the PRISMA-P checklist (online supplementary file 1).

Eligibility criteria
- **Trial design:** Randomised controlled trials comparing prehabilitation (including multimodal prehabilitation interventions) to standard care.
- **Participants:** Adult participants (>18 years) undergoing an orthopaedic surgical procedure.
干预措施：预康复或围手术期干预措施包括锻炼/理疗，患者教育，疼痛管理及焦虑降低策略。

比较：常规或通常护理。

结果：疼痛，肌肉力量，功能，健康相关生活质量（HRQoL）和疾病特异性/关节特异性结果。

语言：所有非英语出版物将被排除（在全文阶段）以避免引入风险。

发表：研究人员仅在调查预康复的有效性后开始在千禧年初的术后结果。

患者和公众参与
患者不直接参与本研究的设计。这是一份系统评价的协议，没有参加者将参与，他们的参与是不适用的。

信息来源
一个全面的电子检索由两个审稿人（AP和OW）将由独立进行在MEDLINE（OVID），CINAHL（EBSCO），AMED（OVID），Embase，PEDro和Cochrane注册临床试验（CENTRAL）从2000年1月到2019年3月25日。我们将访问ISI Web of Science，系统用于从灰色文献和欧洲联盟临床试验数据库中检索相关研究，这些研究正在开展或者未发表。另外，为了获取文章的提要和出版前的印刷和出版论文将被用于在相关期刊中检索骨科（The Bone & Joint Journal，International Orthopaedics，Journal of Orthopaedics and Traumatology）和参考列表中包括的未发表研究将被检索用于进一步相关研究。

检索策略
检索策略将包括干预的意图。医学主题词和关键词将包括以下内容：Rehab*，prehab*，Physiotherapy，Physical therapy'，Presurg*，Preoperat*，Prior，Before，Ahead，RCT和randomi*。见（在线补充文件2）为例的搜索策略MEDLINE。

研究记录
数据管理
特定的参考文献软件EndNote将被使用。

选择过程
标题和摘要（阶段1）由全文本的潜在相关研究（阶段2）将由两个审稿人（AP和OW）将被独立筛选。如果没有摘要可用，全文本文章将被获取和评估为合格。分歧将通过讨论解决。如果没有共识可以达到，第三审稿人（AR）将被咨询。研究过程将被总结使用一套 Preferred Reporting Items for Systematic Reviews and Meta-Analyses流程图。33

数据收集过程和项目
两个审稿人将独立从标准形式提取数据。第三个审稿人将检查数据的一致性和准确性。数据提取将包括以下摘要数据：样本特性，样本大小，感兴趣的结果，持续时间和预康复的交付方法（家居，面对面，电子设备）和预康复的组成部分。

风险个别研究
风险的每个包括的试验将被独立的两个人（AP和OW）评估。在分歧的情况下，第三人（AR）将做决定。每个试验的风险将由两个审稿人（AP和OW）评估。风险将包括以下摘要数据：试验开始日期，试验的注册和未注册的试验，未发表的试验和相关研究。

结果感兴趣
结果感兴趣是疼痛（例如，视觉模拟量表），肌肉力量（例如，四头肌力量通过手动或机动装置测量），功能（例如，Timed Up and Go），HRQoL（例如，EQ-5D）和疾病特异性/关节特异性结果测量（例如，WOMAC）。经济结果措施如停留，再入院率和不良事件也将被报告。

数据综合
定量数据将，如果可能，被分配在统计的元分析使用RevMan 5.3。决策的元分析将考虑个别研究的风险，数据将被纳入和考虑到分析的同一手术程序，人群，干预和一致性的后续时间点，如果可能。一个随机效应模型将被用来自测效应大小。35 标准差（连续型数据）和95%的置信区间将被计算。

风险的个别研究
风险的每个包括的试验将被独立的两个人（AP和OW）评估。在分歧的情况下，第三人（AR）将做决定。每个试验的风险将由两个审稿人（AP和OW）评估。风险将包括以下摘要数据：试验开始日期，试验的注册和未注册的试验，未发表的试验和相关研究。

结果感兴趣是疼痛（例如，视觉模拟量表），肌肉力量（例如，四头肌力量通过手动或机动装置测量），功能（例如，Timed Up and Go），HRQoL（例如，EQ-5D）和疾病特异性/关节特异性结果测量（例如，WOMAC）。经济结果措施如停留，再入院率和不良事件也将被报告。

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analysis and meta-regression would be used to report the factors that could explain the heterogeneity.

Meta-bias(es)
The studies will be assessed for publication bias and selective reporting of outcomes. A search will be conducted in the grey literature and also conference proceedings for national and international conferences in the past 2 years to identify related and unpublished studies. Where insufficient data are available, attempts will be made to contact the authors for further information and will be reported clearly. We will also scrutinise all eligible studies as to whether intended outcome measures were actually reported in the studies. Funnel plots will be used to assess publication and small sample size bias where meta-analysis includes more than 10 trials.

Confidence in cumulative evidence
The overall strength of the body of evidence will be assessed using Grading of Recommendations Assessment, Development and Evaluation. The tool is structured into five domains: risk of bias, imprecision, inconsistency, indirectness and publication bias. Each important outcome will be assessed for the overall certainty in the evidence using three categories: high, moderate, low and/or very low and the authors have the option of decreasing their level of certainty by one or two levels (eg, from high to moderate). Finally, the overall strength of recommendations will be categorised as weak or strong.

DISCUSSION
To the best of our knowledge, this is the first systematic review to include the breadth of prehabilitation interventions prior to orthopaedic surgery including day surgery procedures. These findings may provide evidence to support clinicians in determining if prehabilitation interventions are effective and what components and delivery method is most effective in achieving better outcomes for these patients. This review will also inform further research investigating the effectiveness and the nature of prehabilitation. The Cochrane Risk of Bias tool 2.0 will be used to assess internal validity of each of the included studies and the overall quality of evidence will be reported using Grading of Recommendations Assessment, Development and Evaluation. In order to maintain the strength and quality of our recommendations it was deemed appropriate to limit the review to randomised control trials (RCTs) as RCTs are considered to offer the highest quality of evidence. A limitation of this systematic review is the exclusion of non-English studies, which may mean that some trials conducted in non-English speaking countries may have been omitted.

Ethics and dissemination
This study raises no ethical issues. On completion of this systematic review, the findings will be presented to clinicians and academics at national or international conferences relating to orthopaedics. We will also publish the results in peer-reviewed academic journals to reach clinical and academic experts in this field.

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Contributors VK developed the idea and planning for the review. AP is leading the protocol development and dissemination. AP and OW are the first and second reviewers. AR is the third reviewer. AR and VK ensured review quality. AP, VK and AR have contributed to the design and development of the protocol and all authors will contribute to data interpretation and manuscript draft. VK is the guarantor of the review. All authors have approved this final manuscript.

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Competing interests None declared.

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