

General

Rehabilitation after total or hemi elbow arthroplasty: a systematic review

Karin Hesseberg, PhD^{1,2}^a, Inger Storrorning, M.Sc¹, Silje Mari Urdal Sand, B.Sc¹, Geir Smedslund, PhD^{3,4}

¹ Division of Medical Services, Diakonhjemmet Hospital, ² Faculty of Health Sciences, Department of Rehabilitation Science and Health Technology, OsloMet - Oslo Metropolitan University, ³ National Advisory Unit on Rehabilitation in Rheumatology, Diakonhjemmet Hospital, ⁴ Norwegian Institute of Public Health

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Introduction

Total and hemi elbow arthroplasty (TEA/HEA) are relatively uncommon orthopedic procedures, but physiotherapists are involved in both pre- and postoperative treatment of people who undergo TEA/HEA. The purpose of this article is to summarize existing knowledge about the effects of rehabilitation versus standard care after total and hemi elbow arthroplasty (TEA/HEA).

Methods

A systematic literature review was conducted searching Ovid MEDLINE®, SweMED+, Cochrane, Embase, AMED and PEDro. “The Preferred Reporting Items for Systematic Review and Meta-Analysis” was followed.

Results

No one has studied the effects of rehabilitation after TEA/HEA. The aim of the only study included was to assess the safety and length of hospital stay (LOS) after omission of casting, start of early mobilization and implementation of functional discharge criteria. Results show that the non-casting cohort had a shorter mean LOS (5.4 days) than the index cohort (6.2 days). The cohort with functional discharge criteria had a shorter mean LOS (3.8 days) than the cohort without functional discharge (5.4 days).

Conclusion

Effects of rehabilitation components or programs after TEA/HEA are still unknown. It is important to focus on the lack of evidence in this field, and plan for more studies to come.

INTRODUCTION

Physiotherapists should have an overall goal of implementing evidence-based practice.¹ In the field of rehabilitation after total or hemi elbow arthroplasty (TEA/HEA) physiotherapists have an important role.² Rehabilitation can be defined as “a multimodal, person-centered, collaborative process including interventions targeting a person’s capacity and/or contextual factors related to performance with the goal of optimizing the functioning of persons with

health conditions currently experiencing disability or likely to experience disability, or persons with disability”.³

In general, rehabilitation is recommended related to total joint replacement (TJR) procedures.⁴ Early initiation of physical therapy has demonstrated impact on functional outcomes, costs, length of stay and adverse events in the inpatient setting when compared with standard care.⁵ Most studies detected are on the joint sites hip and knee, and comparison of different rehabilitation protocols or regimes

^a Corresponding author:
Karin Hesseberg, PhD
Division of Medical Services, Diakonhjemmet Hospital
Postbox 23 Vinderen, No-0319 Oslo, Norway
E-mail karhe@oslomet.no

for other sites are hampered by few available studies and heterogeneous interventions.⁶⁻⁸

The elbow joint is a complex joint and has a significant importance in terms of the functionality of the upper limb.^{9,10} This joint has a specific role in linking two body segments, as well as in orienting the hand during everyday activities, and when impaired in function it leads to severe disability for the person affected.¹⁰

Indications for TEA/HEA can be severe inflammatory arthritis, osteoarthritis, and acute fractures.^{2,11,12} Pain and degree of joint destructions are the main indicators for TEA/HEA and when adequate pharmacological, and non-pharmacological treatment does not provide satisfactory symptom relief, surgery is considered the most appropriate treatment option.^{2,11,13}

TEA/HEA are relatively uncommon orthopedic procedures.¹² Results from six national registries from Australia, the Netherlands, New Zealand, Norway, the United Kingdom and Sweden, show that the number of TEAs placed annually is considerably less than that of total hip or total knee arthroplasties (THA, TKA).¹² In the United Kingdom the incidence of TEA was 612 in 2017 compared to 91,698 for THA and 102,177 for TKA.¹² Surgical methods and types of prostheses have been through several changes since the first surgery of TEA/HEA was performed, but the limited number of patients reported and lack of standardized assessments make it difficult to compare results.¹³ Even though elbow arthroplasty continues to experience substantial improvements, the complication rate also remains higher than other arthroplasties. The most common complications of elbow arthroplasty include infection, loosening, wear, triceps weakness and ulnar neuropathy.¹⁴ Further, knowledge on optimal rehabilitation after TEA/HEA is scarce.

Physiotherapists are involved in both pre- and postoperative treatment of people who undergo TEA/HEA. A central aim of the rehabilitation is to optimize recovery regarding elbow motion, often estimated as range of motion (ROM), and the ability to perform activities of daily living.^{2,15} To optimize rehabilitation, the importance of an individualized rehabilitation program and the precautions and functional restrictions should be clear to the patient.² But with a lack of research-based knowledge, recommendations are mainly experience-based.¹⁵ There is a need for a more research-based approach to optimize rehabilitation and improve existing practice in this patient group. It is important to conduct a systematic search on studies regarding rehabilitation after TEA/HEA and detect knowledge gaps to help prioritize the most important future research projects.

The aim of this article is to summarize existing knowledge about the effects of systematic rehabilitation versus standard care after TEA/HEA.

METHODS

The protocol of the present systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO, CRD42021282242), and is conducted in accordance with “The Preferred Reporting Items

for Systematic Review and Meta-Analysis” (PRISMA) (Table S4).¹⁶ Electronic, systematic searches for relevant publications, according to the PICOS form, were conducted in November 2020 and in April/May 2022.

P: Patients in the postoperative phase after total- or hemi elbow arthroplasty, age >18 years. I: systematic rehabilitation / training / physiotherapy. C: regular postoperative follow-up / checks O: primary outcomes: pain, physical function. Other outcomes: Work status, complications (such as infections), quality of life. S: study design was RCTs, non-randomised controlled trials, registry studies, observational studies.

Health science librarians with expertise in systematic literature searches created the specific search strategy, and “Medical Subject Headings” (MeSH) were used to find suitable terms in addition to selected keywords in the searches. The searches were limited to publications written in English, Norwegian, Swedish and Danish. The following databases were searched to find relevant studies: Ovid MEDLINE®, SweMED+, Cochrane, Embase, AMED and PEDro. Search histories are documented in S1.

Inclusion criteria:

- RCTs, non-randomised controlled trials, registry studies, observational studies (retrospective studies or prospective studies)
- age > 18 years
- surgery with a total- or hemi elbow arthroplasty
- description of rehabilitation / training / postoperative follow-up/physiotherapy.
- Outcomes: Pain, physical function, work status, complications, and quality of life

Exclusion criteria:

- published before year 2000
- Studies on animals and cadavers
- Case reports, case series and abstracts

One reviewer (KH) first reviewed the results from the search to delete duplicates. Furthermore, three reviewers evaluated all titles and abstracts individually, and further evaluated the articles that were selected in full text (KH, IS and SMUS).

The Newcastle-Ottawa scale for cohort studies was used for the quality assessment of included studies.¹⁷ One reviewer assessed the quality of the included study (GS), and the assessment were discussed with the other authors of the review. One reviewer (GS) extracted data from included studies, and the other authors checked the data against the full texts. For each outcome, we extracted data on all measures and all time-points. We extracted information on country in which the study was conducted, aims of the study, methods, participant characteristics, interventions, and outcomes.

For continuous outcomes, we used standardized mean differences (Cohen’s d), and for dichotomous outcomes we used risk ratios and number needed to treat to present results. If the populations, interventions, and outcomes were sufficiently similar, we planned to perform random-effects meta-analyses using Review Manager (REF). For studies

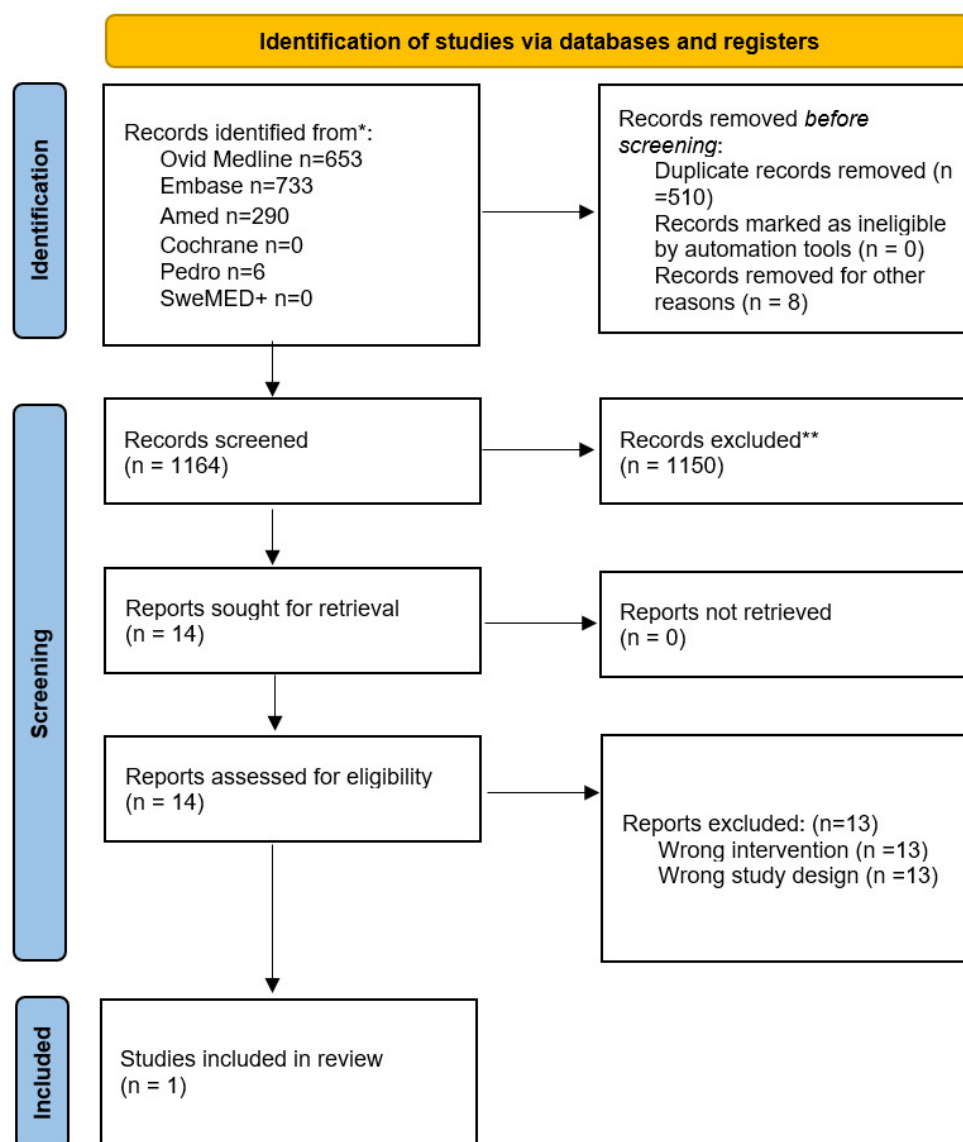


Figure 1. Flowchart of the inclusion process

with only one group, we planned to use the R package (metafor) and perform meta-analyses of proportions. We planned to construct forest plots to display results and funnel plots for exploring heterogeneity if there were results for more than ten studies. Planned subgroups analyses were total versus hemi elbow arthroplasty. If standardized mean differences or risk ratios were not reported, we attempted to convert the reported data to these measures. If this was not possible, we planned to contact the authors to obtain the data. After the protocol was published, we decided to use the Grading of Recommendations Assessment, Development and Evaluation (short GRADE) framework to assess certainty (or confidence) in the body of evidence for an outcome.¹⁸

RESULTS

A Flowchart of the inclusion process from searches in Ovid MEDLINE®, SweMED+, Cochrane, Embase, AMED and PEDro are presented in [Figure 1](#).

We included one study by Prki et al.¹⁹ Details of the study are presented in [Table 1](#), and rating of the study are presented in S3. An overview of the excluded full text studies is presented in Table S2.

Prki et al¹⁹ implemented ‘functional discharge criteria’ for TEA patients. These criteria were defined as adequate mobility to resume the activities of daily living, sufficient pain control for physiotherapy exercises and a wound that addressed no further specialized care. Three cohorts were made; first the index cohort (n = 70), which consisted of all patients that received an arthroplasty before January 1st, 2016, when the institutional policy to omit casting post-operatively was introduced. Second, a cohort of patients without functional discharge criteria (n = 31) was labeled as ‘empirical discharge’. Third, a cohort with functional discharge criteria (n=25) was defined with all patients who received a primary TEA since August 2017.

Results for the main outcomes (pain, physical function): There were no results for pain or physical function.

Table 1. Characteristics of the included study

Study	Aims of study	Country and patients (n=126)	Methods	Interventions	Outcomes
Prki 2020	To assess the safety and length of stay after omission of casting, start of early mobilization and implementation of functional discharge criteria after total elbow arthroplasty (TEA)	The Netherlands Mean age: 69 (7.6) Gender: 18 male, 108 female Indication: Primary osteoarthritis: 8 (6), Secondary osteoarthritis: 71 (56), rheumatoid arthritis: 33 (26), fracture: 12 (9), metastasis: 2 (2)	Retrospective review of patients' records who received a Coonrad-Morrey TEA in the period from January 1st, 2011 to December 31st, 2018. Follow-up was performed on the outpatient clinic after 2 weeks, 3 months and 1, 3, 5, 7 and 10 years in all cohorts	Omitting a post-operative cast Introduction of functional discharge criteria	Length of hospital stay Range of motion after 1 year Number of complications Wound leakage requiring specialized wound care

Results for other outcomes (work status, complications (such as infections), quality of life.): There were no results for work status or quality of life.

The non-casting cohort had a shorter mean length of stay (5.4 days, SD =2.0) than the index cohort (6.2 days, SD = 3.4). A Mann-Whitney U test was statistically significant ($p < 0.001$). Because Prki et al¹⁹ reported non-normal distributions, we have not estimated Cohen's d.

The cohort with functional discharge criteria had a shorter mean length of hospital stay (3.8 days) than the cohort without functional discharge (5.4 days). The Mann-Whitney U test was statistically significant ($p < 0.001$). Because Prki et al¹⁹ reported non-normal distribution, we have not estimated Cohen's d.

Because we only included one study, we could not perform meta-analyses.

DISCUSSION

This review aimed to summarize existing knowledge about the effects of systematic rehabilitation on pain, physical function, work status, complications, and quality of life versus standard care after TEA/HEA. However, after performing the literature searches, we found no articles addressing this topic. One study was included, and the aim of this study was to look at the safety and length of stay after omission of casting, start of early mobilization and implementation of functional discharge criteria after TEA. No studies addressing HEA was included.

The study included in this systematic review addressed the use of cast and splint.¹⁹ In 2020, the book "Elbow Arthroplasty"²⁰ were published with one of the chapters addressing post-operative management and one of the recommendations is to place the arm in a splint.² This recommendation is in contrast to the findings in the article by Prki et al¹⁹ who report that omitting a post-operative cast in combination with functional discharge criteria led to shorter length of stay, without higher complications rates. However, although this procedure seems to be safe, and challenges some of the existing recommendations, we must

take into consideration that only 125 patients were included in this study. Results of the article of Prki et al¹⁹ support that physiotherapists and surgeons should look into their recommendations for restrictions and rehabilitation after TEA. In 2006, Szekeres et al²¹ stated that there were no scientific papers looking at benefits of physiotherapy after TEA/HEA, but the authors believed that physiotherapy can provide benefit for these patients.²¹ Although this was communicated in 2006, there is little new research in this field. Postoperative management are described in several studies,²²⁻²⁷ but in many cases the recommendations appear to be based on the surgeon's recommendation and not scientific results. Recommendations for rehabilitation after TEA/HEA is largely focusing on post-operative restrictions, and further active and passive movements with the aim of increasing range of motion (ROM).² Barlow et al²⁸ studied the activity level of the patients after TEA and their compliance to postoperative restrictions. The results showed that only 64% of the patients accurately remembered and were compliant with their postoperative restrictions. The authors state that it is unclear whether these restrictions will provide increased longevity of the implants, but three of four surgeons counselled the patients not to lift anything weighing over 10 lb or to repetitively lift more than 2 to 3 lb.²⁸ The fourth surgeon in this study recommended the patients to limit the total cumulative stress without specific restrictions. The authors did not report whether there were differences in activity level between the patients receiving specific restrictions and those who did not.²⁸ It would be of interest to get more knowledge about differences in complication rate between patients receiving different recommendations from the surgeon, and further, which recommendations for rehabilitation will lead to best results for the patients.

As mentioned, we could not find any studies supporting recommendations for postoperative exercise after TEA/HEA, which is in contrast to for example other joint sites such as knee arthroplasty.²⁹⁻³² Pozzi et al³¹ conclude in their systematic review regarding physical exercise after TKA that optimal outpatient physiotherapy protocols

should include: strengthening and intensive functional exercises given through land-based or aquatic programs, the intensity of which is increased based on patient progress. Another systematic review and meta-analysis by Chen et al²⁹ summarized the effects of progressive resistance training (PRT) for early postoperative fast-track total hip or knee arthroplasty. They concluded that PRT is one of the options for rapid rehabilitation after joint replacement.²⁹ A systematic review addressing effectiveness of physiotherapy exercise following TKA included 18 RCTs and concluded that interventions including physiotherapy and exercise after TKA showed short-term improvements in physical function.³² Another study aimed to evaluate the effectiveness of formal physical therapy following total shoulder arthroplasty (TSA), and included one RCT in their systematic review.³³ Results from this study showed that immediate provision of passive- and active-assisted ROM exercises provides short-term benefits in pain and function, when compared to a delayed approach.³³ Edwards et al³³ conclude in their review that there is an urgent need for high-quality, adequately powered RCTs to determine the effectiveness of rehabilitation programs following TSA, and that the volume of RCTs evaluating rehabilitation interventions following THA and total TKA is a stark contrast.^{32,34,35} Results from our systematic review show an even greater contrast because we found no RCTs addressing the topic rehabilitation after TEA/HEA.

The low incidence of TEA/HEA can explain some of the reason why there are less RCTs addressing rehabilitation after TEA/HEA compared to other joint sites, because it is difficult to have enough power in a study without large cohorts of patients.¹² However, could results from studies regarding exercise after TKA been taken more into the discussions regarding recommendations to rehabilitation after TEA/HEA? Both of these joints are classed as hinge-type synovial joints,³⁶ and we can ask whether the recommendation on exercise after TKA can also apply to patients who have undergone surgery for TEA/HEA. One obvious counterargument is of course the different requirements in terms of load, type of weight-bearing joints, weight arm and so on, but while restrictions after TKA are short-term, the restrictions after TEA/HEA are permanent. Because no studies have looked at rehabilitation or exercise after TEA/HEA we cannot know if these permanent restrictions are needed, or whether a structured rehabilitation program will improve complications rate and function. Complications such as loosening of the prosthesis and infections are outcomes often reported after TEA/HEA.^{14,37,38} A question to be raised is whether these complications are related to the rehabilitation after surgery, the implant, or the surgery procedure. Perhaps a more systematic and knowledge-based rehabilitation strategy can reduce such complica-

tions, and in addition improve physical function, activities of daily living and quality of life. According to results from this study, based on research as of today, there are yet no answers to these questions.

Limitations of the review process could be the lack of automation tools used, and the possibility that we may have overlooked relevant articles. However, three persons screened the articles and were included in the selection process which reduces the risk that relevant articles have not been included.

CONCLUSION

No one has studied the effects of rehabilitation components or programs after TEA/HEA. The effects of such rehabilitation are unknown. Even though this is a small patient group worldwide, it is important to focus on the lack of evidence in this field, and plan for more studies to come.

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AUTHORS' CONTRIBUTION

The Vancouver convention was followed. KH, IS and SMUS researched literature and conceived the study. KH (introduction and discussion) and GS (methods and results) wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

CONFLICTING INTERESTS

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SUPPLEMENTARY MATERIALS

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