# Review Paper: The Effect of Splinting After Dupuytren's Contracture Operation: A Systematic Review

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## ABSTRACT

**Objectives:** Flexion contracture in fingers of hands is a complication of Dupuytren's contracture and cannot be stopped by the progressive course. The aim of this study was to review the effect of splinting in the correction of contracture after Dupuytren's contracture operation.

**Methods:** To carry out this research, a kind of systematic evidence-based review process (Duffy 2005) was used. For data gathering, we used electronic database and Persian- and English-language specific journals between 1990 and January 2019. The keywords were related to examine the effect of various splinting after Dupuytren's contracture operation.

**Results:** After data gathering, 26 articles about Dupuytren's contracture were found; after checking and deep reviewing of those articles, 17 articles were removed from the study and 9 articles were included in the study for reviewing. The results of a review article based on using splint in Dupuytren's contracture after operation were classified into 6 categories, including static splint, dynamic splint, day splint, night splint, the time duration of splinting, and prescribed time of splinting.

**Discussion:** Splint alone has been ineffective in reducing contracture. Static splint and hand therapy (exercise) are together the most effective way for the treatment of Dupuytren's contracture. Occasional and irregular use of splint also has no effect on pain relief and the reduction of contracture. The pressure and force of splint will be gradually increased, and the splint should be used at least for 3 months, too.

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## Highlights

- The most effective way for the treatment of Dupuytren's contracture is to use splint after the operation.
- Exercise with the splinting effect is ineffective in reducing the contracture.
- Night static splints are effective in improving the range of motion and performance of their hands of Dupuytren's contracture.

## Plain Language Summary

Dupuytren's contracture is a controversial problem with orthopedics and rehabilitation. It is commonly used in surgical procedures, splint administration, and rehabilitation exercises. Considering the experience and studies of rehabilitation specialists, simultaneously, these methods have a more favorable outcome in improving hand function. Surgical technique, type of exercise, and how to use the splint are very important. According to the results of this study, splinting with postoperative exercises was more effective in surgical outcomes. Of course, the duration of using the splint, how to use it overnight or daily, and the length of use of the splint for better treatment results should be addressed to therapists.

## 1. Introduction

Dupuytren's Contracture (DC) or Dupuytren's Disease is a kind of active and benign cell proliferation in the palmar facial tissue that can lead to disability [1]. It develops in middle age and creates a progressive flexor contracture in the hands, especially along with the index and little fingers. Palter (1614) was the first expert to explain the disease that it was a type of disorder in palm facial was read by hard-working people. In 1831, Guillaume Dupuytren's expanded the previous approach, and he described the disease as cellular proliferation. This proliferation results in the formation of a nodule in the palm of the hand, and palmar fascia becomes rope-shaped and this is what leads to the creation of flexor contracture on the joints of the fingers.

Flexion contracture is a natural part of this disorder and cannot be stopped by the progressive course. The underlying cause of this disorder is still unknown, but the factors that may be lead to this disorder include genetic factors, race, gender (in men 8-9 times more likely than women), cancer, epilepsy, thyroid disorders, AIDS, alcohol, and smoking [2]. Therefore, we cannot slow down the course of this disease, and no conservative treatments such as splinting can delay progress. The main treatment is operation (fasciotomy, Z-plasty, skin graft), which is raised after that the need for rehabilitation. The surgical criterion is the presence of 35-degree flexion contracture in metacarpophalangeal and proximal interphalangeal joints [1-3]. Since the operation leads to scar formation, the temporary limitation of hand functions in order to carry out activities of daily living and occupation, sensory problems, edema, and abnormalities in blood circulation to surrounding tissues.

Occupational therapy can be used for hand rehabilitation after assessments in the field of skin and ulcer, pain, sensation, active and passive range of motion, how to do activities of daily living, and by prescribing a series of exercises (e.g. flexion and extension active motions in fingers) and specific splinting and also ergonomic reforms come into effect [2]. The purpose of splinting after the operation is to maximize the movement of extension on the fingers [1]. The splint used for postoperative DC is a Paddle splint [3]. This splint can be used in a variety of ways; palmar or dorsal, and static or dynamic, in which the static type is used in further treatment [4]. There are different opinions and results about the effect of splinting after Dupuytren's operation and the duration of the use of this method, the position of the wrist and fingers in terms of angle, and the amount of force that should be applied to the various joints.

Larson and Jerosch-Herold (2008) in a review article concluded that there was little evidence to support the impact of splinting after DC operation, and this limited evidence was also used to confirm the effect of static or dynamic splint on reducing the rate of expansion defects in severe flexion contracture (equal to and greater than 40 degrees); proximal interphalangeal joints have contradictory meanings. This limited evidence to support the static or dynamic splinting effect on reducing extreme flexion contracture defects in the extension (equal to or greater than 40 degrees) of proximal interphalangeal joints were contradictory meanings [5].

Another study was conducted by Jerosch-Herold et al. in 2008 to investigate the effect of splinting after DC operation. The result of this study showed that more studies were required to confirm the clinical effect of night splinting after fasciotomy or derma fasciotomy operation of DC [6]. Considering the fact that most studies were done about the effect of splinting after DC operation, further studies are required in this regard, and regarding the important role of hands in performing various types of activities of daily living and the consequences of injuries, there is a need for more research in this regard. Therefore, this review study aimed at investigating the effect of splinting after DC operation.

## 2. Methods

To carry out this research, a kind of systematic evidence-based review process (Duffy 2005) was used [7].

### Search strategy

For data gathering, all Persian articles, which examined the effect of various splinting after DC operation, as well as related published foreign articles between 1990 and January of 2019, were used. The following sources were: 1) Electronic databases, including Medlin, PubMed, Google Scholar, CINAHL, Ovid, Cochrane, ProQuest, Up to Date, Web of Science, OT search, OT direct, OT BibSys, Pedro, SID, Magiran, Iran Medex, Madlib, and Iran doc, 2) Iranian and foreign famous journals, including Iranian Rehabilitation Journal (IRJ), Iranian Journal of Child Neurology (IJCN), Archive Physical Medicine and Rehabilitation (APMR), Developmental Medicine, American Journal of Occupational Therapy (AJOT), Koomesh, Archives of bone & joint operation, Rehabilitation journal, Journal of Medical Council of Iran, Journal of Research in Rehabilitation Science, and Hand Therapy Journal. The keywords used individually or in combination according to the MeSH were as follow: "Dupuytren's contracture", "splinting", "post-operative splinting", "systematic review", "management for Dupuytren's contracture", "hand therapy", "rehabilitation", and "occupational therapy".

### Inclusion and exclusion criteria

The inclusion criteria were research studies on the effect of static, dynamics, and day and night splints on the pain reduction of postoperative DC operation. All retrospective and prospective papers, experimental and quasi-experimental studies, or observational studies that reviewed the effects of night/day, dynamic/static splints at least 10 to 14 days after the operation and up to 2 months after the operation have entered this study. Articles that studied the effects of splinting on problems other than DC were removed from the study. The articles included in this study were in I, II, and III levels of evidence-based on the evidence-based model [8, 9]:

Level I—randomized controlled trials (RCTs), systematic reviews, and meta-analyses

Level II—non-randomized studies (e.g., cohort, case-control) and two groups

Level III—one group, non-randomized studies (e.g., pretest-posttest)

Level IV—descriptive studies that include analysis of outcomes (e.g., single-subject design, case series)

Level V—case reports and expert opinion that include narrative literature reviews and consensus statements

All of the articles that were theses, presentations, and conferences that were in the levels IV and V evidence were excluded from this review (Table 1).

**Table 1.** Inclusion and exclusion critera

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Iranian and English article about the DC | Articles that were found other than Persian or English. |
| Related articles between 1990 and January 2019. | Articles that had been done before 1990. |
| Articles related to the effects of splinting on postoperative DC. | Articles related to the effects of splinting on other disorders and contractures. |
| The availability of full-text articles or abstracts. | Articles related to the effect of splinting before the DC operation. |
| Retrospective and prospective papers, experimental and quasi-experimental studies, or observational studies that reviewed the effects of night/day, dynamic/static splints at least 10 to 14 days after the operation and up to 2 months after the operation. | Theses, presentations, conferences, and articles were in the level IV and V evidence. |

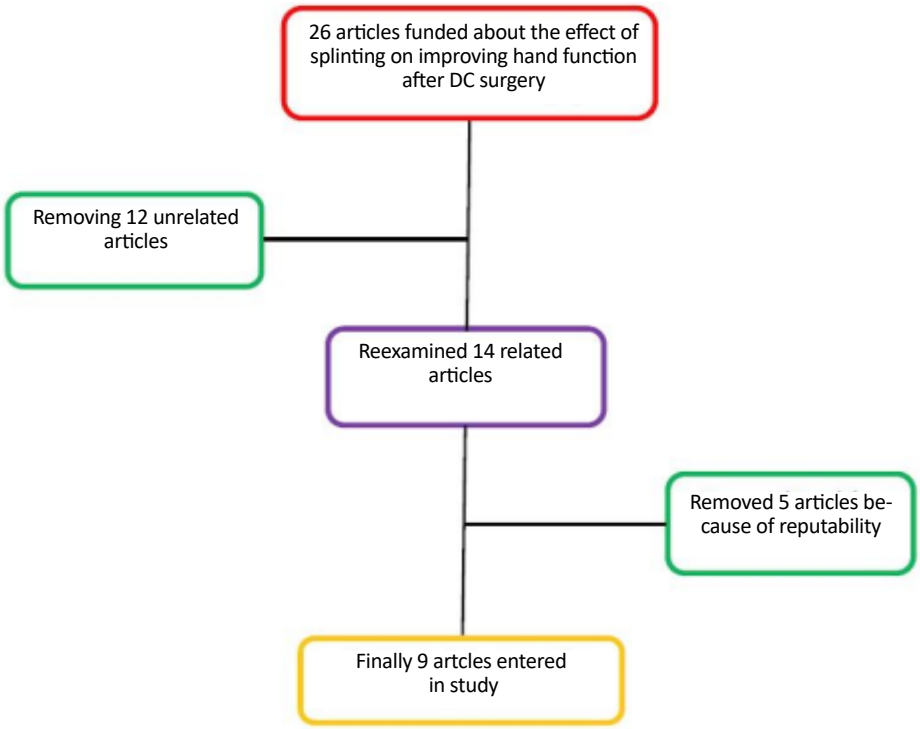


**Figure 1.** Flowchart of study selection

Iranian Rehabilitation Journal

## 3. Results

A total of 26 articles on the effect of splinting on improving hand function after DC operation with 22 articles with full-text and 4 abstracts were found. After reviewing the abstracts of the articles and the text of the articles, 12 articles related to the effects of splinting after the DC operation, which included the inclusion criteria were selected. After deep reviewing of those 12 articles, 3 of them were removed because of repeatability and, finally, 9 articles (8 were at the level of I evidence [6 RCTs and 2 reviews] based on level and 1 was at level III) entered this study (Figure 1).

### The methodological quality of the included studies

Table 2 presents the results of the methodological quality assessment of the 7 included RCTs studies. Four of the 6 RCTs included in our review were of high quality (67%). Another 2 RCTs scored 40% to 50% of the total score (33%). Based on the methodological quality of the assessment, if the quality of studies is >50%, it is high quality, if it is 50>quality >30, the quality is moderate, and if it is <30, it is low quality [10].

The results of the review of the articles led to the classification of the study into 6 categories, including 1) The effect of static splint after DC operation, 2) The effect of dynamic splint after DC operation, 3) The effect of day splint after DC operation, 4) The effect of night splint after DC operation, 5) The effect of time duration of splinting after DC operation, and 6) The effect of the prescribed time of splinting after DC operation. Table 3 presents the results of the review articles.

## 4. Discussion

Since DC is considered as a progressive disorder, there is no definitive treatment for this disorder. Nevertheless, in the middle to severe phases, the first line is fasciotomy operation. After the operation and also in the first phases of the disease, the best and most effective intervention is rehabilitation, which includes all hand therapy modalities and splinting. Dynamic and static splints are among the most commonly used splints in these patients and can be used either overnight or throughout the day [11]. According to the study, it was found that the best and most useful splints among patients with DC are the static splints. However, in a study by Rives et al., the long-term use of dynamic splints could improve the extension movement of the proximal interphalangeal joints of fingers [12].

Regarding the splint administration time, there was no definitive conclusion. In the study of Jerosch-Herold et al., splint administration was reported 10 to 14 days postoperatively with lower pressure and more effective than late injection with high force splint [6]. In connection with the use of splint during the night or day, most

**Table 2.** Methodological quality scores of the included RCTs

| Study | Adequate Randomization? | Allocation Concealment? | Blinding? Patients? | Blinding? Caregiver? | Blinding? Outcome Assessors? | IncompleteOutcome Data Addressed? Dropouts? | IncompleteOutcome Data? ITT Analysis? | Free of Suggestions of Selective Outcome Reporting? | Similarity of Baseline Characteristics? | Cointerventions Avoided or Similar? | Compliance Acceptable in All Groups? | Timing of the Outcome Assessment Similar? | Score Maximum | Study Score | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jerosch-Herold et al. (2008) [6] | ? | ? | - | - | ? | + | + | + | + | + | - | + | 12 | 6 | 50 |
| Collis et al. (2013) [10] | ? | ? | - | - | ? | + | + | + | + | + | - | + | 12 | 6 | 50 |
| Ebskov et al. (2000) [11] | ? | ? | - | - | ? | + | + | - | + | + | - | + | 12 | 5 | 42 |
| Rives et al. (1992) [12] | ? | ? | - | - | ? | + | + | + | + | ? | n.a. | + | 12 | 5 | 42 |
| Kemler et al. (2012) [13] | + | + | - | - | + | + | + | + | + | - | ? | + | 12 | 8 | 67 |
| Jerosch-Herold et al. (2011) [14] | ? | ? | - | - | ? | + | + | + | + | + | - | + | 12 | 6 | 50 |

Iranian Rehabilitation Journal

+: yes; -: no; ?: unsure; ITT: Intention To Treat; n.a: not applicable (in a 1-time intervention, such as operation, hand therapy, compliance is not an issue).

studies also emphasized the ineffectiveness of nighttime splinting and suggested the use of splint during the day, although unpleasant for the individuals [5, 6, 13-16]. Most studies about the DC suggested that the rehabilitation (exercise) and splinting each alone have been ineffective in reducing the contracture of these individuals; they also concluded that occasional and irregular use of splint also has no effect on pain relief and the reduction of contracture [11, 13].

## 5. Conclusion

The most effective way for the treatment of DC is to use a splint (preferably static) and hand therapy (exercise) together. In addition, after the operation, hand rehabilitation and splint with low pressure should be administered as soon as possible. The pressure and force of splint will be gradually increased, and the splint should be used at least for 3 months too.

The lack of access to free hand therapy journals is one of the limitations of this study. Also, a small number of papers in the impact analysis of splint, especially day/night and static/

**Table 3.** The results of the review articles

| | No. of Articles | First Author | Year Publication | Type of Study | Sample Size | Results | Conclusion |
|---|---|---|---|---|---|---|---|
| Static Splint | 5 | Jerosch-Herold et al. [6] | 2008 | RCT | 15 | The use of static splints has been effective in improving the range of motion and performance of their hands. | The static splint in people with severe DC and its long-term use can be effective in improving the performance of these individuals. There are not any differences between using splints and hand therapy with hand therapy alone but using splint maintains this improvement longer than hand therapy alone. |
| | | Collis et al. [10] | 2013 | RCT | 56 | There were no statistically significant differences between the no-static orthosis and static orthosis groups for total active extension or for any of the secondary outcomes. Between the first postoperative measure and 3 months after the operation, 62% of little fingers had maintained or improved total active extension. | |
| | | Bionka et al. [15] | 2018 | Review | 290 | This study concluded that splinting (static) and hand therapy had the same effect on DC patients and these interventions can be used after the operation and none is overcome to another. | |
| | | Larson et al. [5] | 2008 | Review | 28 | The use of static splint in the postoperative phase in people with severe DC increases the extension of their fingers and is more effective in long-term use. | |
| Dynamic Splint | 4 | Ebskov et al [11] | 2000 | RCT | 15 | Usage and dis usage of The dynamic splinting have no affected on hand function and even on the postoperative restoration of the contracture. It is even better not to use splint after the operation to have a better and more comfortable manipulation of the fingers. | The use of dynamic splinting if combined with other rehabilitation treatments can help to improve the performance of the hand. |
| | | Rives et al. [12] | 1992 | RCT | 27 | The use of dynamic splinting, if used simultaneously with other rehabilitation interventions, has more pronounced effectiveness with DC, especially in PIP joints. | |
| | | Larson et al. [5] | 2008 | Review | 28 | The use of dynamic splint in the postoperative phase in people with severe DC increases the extension of their fingers and is more effective in long-term use. | |
| Day Splint | 1 | Larson et al. [5] | 2008 | Review | 28 | In this paper, there was no difference between the use of day splint and night, and the difference was more in the static or dynamic. | There is no significant difference in the use of the day splint, night splint, and only the most important point is to use splinters i n postoperative DC. |
| Night Splint | 6 | Jerosch-Herold et al. [6] | 2008 | RCT | 15 | The use of night static splints has been effective in improving the range of motion and performance of their hands. | The use of night splint to reduce the contracture, reduce pain and increase strength, and increase the range of motion of fingers is not very impressive. However, there is a need for more and more specific studies among people with DC. |
| | | Larson et al. [5] | 2008 | Review | 28 | In this paper, there was no difference between the use of day splint and night, and the difference was more in the static or dynamic. | |
| | | Jerosch-Herold et al. [14] | 2011 | RCT | 148 | The use of night static splints has been effective in improving the range of motion, satisfaction, and performance of participants. | |
| | | Collis et al. [10] | 2013 | RCT | 56 | The participants were instructed to apply the orthosis overnight and remove it during the daytime. | |
| | | Bionka et al. [15] | 2018 | Review | 290 | This study concluded that splinting and hand therapy had the same effect on DC patients and these interventions can be used after the operation and none is overcome to another. | |
| | | Glassey et al. [16] | 2001 | Pre/post-test | 31 | It was suggested in this article that the use of night splints has no effect on increasing the extension of fingers, reducing pain, increasing strength, and reducing flexor deformity in the fingers. | |

| | No. of Articles | First Author | Year Publication | Type of Study | Sample Size | Results | Conclusion |
|---|---|---|---|---|---|---|---|
| Duration of Splint use | 8 | Jerosch-Herold et al. [6] | 2008 | RCT | 15 | In this study, the static splint was used for 6 months, which was administered 10 to 14 days after the operation. | The duration of splinting depends on the patient's acceptance and the therapist's opinion. Long-term use of at least 3 months and the use of static splinting can be effective. |
| | | Rives et al. [12] | 1992 | RCT | 27 | In this study, the participants used the dynamic splints for at least 6 months. | |
| | | Kemler et al. [13] | 2007 | RCT | 54 | In this study, the participants used the splints for at least 3 months. | |
| | | Jerosch-Herold et al. [14] | 2011 | RCT | 148 | In this study, the splint was used for 1 year (12 months) by postoperative DC. Of course, evaluations are after 3 months, 6 months, and finally 12 months. | |
| | | Ebskov et al. [11] | 2000 | RCT | 15 | In this study, individuals used a dynamic splint for 9 months after DC operation. | |
| | | Collis et al. [10] | 2013 | RCT | 56 | In this study, the splint was used for 3 months after the DC operation. | |
| | | Bionka et al. [15] | 2018 | Review | 290 | The 3 studies that were included in this study used splint between 3 and 12 months. | |
| | | Larson et al. [5] | 2008 | Review | 28 | In this study, the splint was used in at least 6 weeks (1.5 months). | |
| Time of prescription | 4 | Jerosch-Herold et al. [14] | 2011 | RCT | 148 | In this study, night static splint was prescribed to patients immediately after the operation. Patients used a night static splint for 3 weeks that did not enter the tension and compression to the wound. After 3 weeks, and since the wound healing was because of operation, another static splint was prescribed to the patients. | The time of splint administration is because of a number of factors, including the type of operation, the severity of contracture, the number of times a person has undergone the operation, and the decision of the therapist. However, faster administration of the splint after the operation can have a better effect. |
| | | Jerosch-Herold et al. [6] | 2008 | RCT | 15 | In this study, the static splint was prescribed to patients 10 to 14 days after the operation. | |
| | | Bionka et al. [15] | 2018 | Review | 290 | In this study, the splint was used for 3 months after the DC operation. | |
| | | Larson et al. [5] | 2008 | Review | 28 | In this study, the splint was administered to the patients with DC immediately after the operation. | |

dynamic, are among the other limitations of this study. It is suggested that the hand-therapists and occupational therapists examine the impact of splinting and different kinds of splints types on DC.

## Ethical Considerations

### Compliance with ethical guidelines

The Ethics Committee of Iran University of Medical Sciences approved this study (Code: IR.IUMS.REC. 28930). All participants signed informed consent to participate in the study. A code number was placed on each participant's name to provide confidentiality.

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### Authors' contributions

Conceptualization: Akram Azad, Ghazale Golabi; Methodology: Akram Azad, Malek Amini; Investigation: Gazaleh Golabi, Marzieh Pashmdarfard, Malek Amini; Writing – Original Draft: Akram Azad, Marzieh Pashmdarfard; Writing – Review & Editing: Akram Azad, Marzieh Pashmdarfard; Supervision: Akram Azad.

### Conflict of interest

The authors declared no conflict of interest.

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