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Comparison of Hand Therapy with or without Splinting Postfasciectomy for Dupuytren's Contracture: Systematic Review and Meta-Analysis

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Abstract

This study aimed to compare the outcomes of hand therapy alone versus additional splinting post fasciectomy for Dupuytren's contracture patients. A systematic review and meta-analysis were conducted, and a search was performed identifying all relevant studies comparing the two groups. Primary outcome measures included Total active flexion and extension (TAF and TAE) and Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Secondary outcome measures included pain intensity, grip strength, and global perceived effect and patients' satisfaction. A random effects model was used for the analysis. Four RCTs were identified enrolling 295 patients. There were no significant differences between hand therapy and splintage groups in terms of all outcomes (both primary and secondary). Splintage offers no added functional benefit to hand therapy alone for post fasciectomy patients with Dupuytren's contracture, however, orthotic regimes may still be applied on an intention to treat basis in those patients who develop an extension deficit postoperatively.

Keywords
- hand therapy
- splinting
- Dupuytren's contracture
- fasciectomy
- postfasciectomy

Introduction

Dupuytren's disease is a common fibroproliferative condition involving the palmar fascia of the hand.[1] Collagen proliferation leads to the formation of hard fibrous nodules and cords that cause progressive digital flexion. Without intervention, this can result in disabling contractures of the fingers.[2] Surgical procedures such as fasciotomy or fasciectomy involve the division or excision (respectively) of diseased tissue to release the contractures. However, recurrence rates of up to 80% have been reported.[3] Patients receive hand therapy as part of their rehabilitation postoperatively.[4] Therapy commonly includes hand exercises with or without splinting, with proponents of each method demonstrating good outcomes.[4]

In order to optimize extension deficit correction and prevent postoperative contractures, many surgeons advocate the practice of nocturnal extension splinting of the digits until the collagen has matured.[4] Surveys of surgeons and other health care professionals identified that between 55 and 98% of respondents feel that there is a role for orthosis following surgery.[5–7] However, some clinicians believe that splinting can be counterproductive, as the stress of the splint can lead to excessive proliferation of collagen and therefore can cause reccurence.[8] The addition of an orthotic regime adds to the cost of treatment[9] (both financially and the therapist's time with the patient).

Although many surgeons incorporate night splints into their management of Dupuytren's contractures, there are currently no definitive guidelines in relation to this. Hand therapy and splinting after surgery for Dupuytren's contractures have been compared in several randomized controlled trials and a nonrandomized study, as well as a systematic review.[10–14] There is currently no meta-analysis that quantitatively compares their functional outcomes. We aimed to conduct a meta-analysis with the aim of helping to further

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the evidence base to optimize postoperative outcomes as well as to effectively utilize available local resources.

Materials and Methods

A systematic review and meta-analysis were conducted as per the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[15]

Eligibility Criteria

All prospective randomized and nonrandomized control trials as well as observational studies comparing hand therapy with splinting versus hand therapy alone postfasciectomy for Dupuytren's contracture were included. Splintage with hand therapy was the intervention group of interest, and hand therapy alone was the control group. All patients were included regardless of age or comorbidity status. Articles in which other treatment modalities were implemented other than fasciectomy or dermofasciectomy were excluded including collagenase injections and fasciotomies.

Primary Outcomes

The primary outcomes were mean improvement in total active flexion (TAF), total active extension (TAE), and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire scores from baseline under both treatment cohorts. Total active flexion is defined as the mean flexion in degrees per digit accounting for the metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints. Similarly, Total active extension is the mean extension in degrees for each digit for the MCP, PIP, and DIP joints. The DASH questionnaire is a 30-item questionnaire as a measurement of symptoms and physical function for patients with upper extremity disorders, which has been used broadly to assess postoperative outcomes for Dupuytren's contracture in numerous reports.[16–18]

Secondary Outcomes

The secondary outcomes included pain intensity, grip strength, global perceived effect, and patient satisfaction.

Literature Search Strategy

Three authors independently searched the following electronic databases: MEDLINE, EMBASE, EMCARE, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL). The last search was run on October 18, 2020. Thesaurus headings, search operators, and limits in each of the above databases were adapted accordingly. In addition, World Health Organization International Clinical Trials Registry (http://apps. who.-int/trialsearch/), ClinicalTrials.gov (http://clinical- trials.gov/), and ISRCTN Register (http://www.isrctn. com/) were searched for details of ongoing and unpublished studies. No language restrictions were applied in our search strategies. The search terminologies included "Splint*," "orthos*," "Hand Therapy," "Hand Physio*," "Hand Physical Therapy," "Hand Rehab*," "Hand Physio*," "Occupational Therapy," "Hand Massage," and "Dupuytren's*." The bibliographic lists of relevant articles were also reviewed.

Selection of Studies

The title and abstract of articles identified from the literature searches were assessed independently by each author. The full texts of relevant reports and those selected that met the eligibility criteria for the review were retrieved. This included articles which had two groups of patients, an intervention and control group comparing splintage and hand therapy with hand therapy alone post-fasciectomy for Dupuytren's contracture. Articles not reported in English were excluded. Any discrepancies in study selection were resolved by discussion between the authors.

Data Extraction and Management

An electronic data extraction spreadsheet was created in line with Cochrane's data collection form for intervention reviews.[19] The spreadsheet was pilot tested in randomly selected articles and adjusted accordingly. Our data extraction spreadsheet included study-related data (first author, year of publication, country of origin of the corresponding author, journal in which the study was published, study design, study size, clinical condition of the study participants, type of intervention, and comparison). Three authors cooperatively collected and recorded the results, and any disagreements were solved via discussion.

Data Synthesis

Data synthesis was conducted by using Review Manager 5.3 software. The analysis used was based on the random effect model. The results were reported in forest plots with 95% confidence intervals (CIs). For continuous outcomes, the mean difference (MD) was calculated between the two groups. A positive MD for the TAF, TAE, or DASH score was in favor of the hand therapy group, a negative MD favored the splinting group, and a MD of 0 favored neither groups.

Assessment of Heterogeneity

Heterogeneity among the studies was assessed by using the Cochran Q test (Chi-square). Inconsistency was quantified by calculating I^2 and interpreted by using the following guide: 0 to 25% was representative of low heterogeneity; 25 to 75% was indicative of moderate heterogeneity; and 75 to 100% was viewed as a high heterogeneity.

Methodological Quality and Risk of Bias Assessment

The Cochrane Collaboration's Tool was used to assess the quality of the RCTs included in the study (►**Table 1**). The tool assesses several domains in each paper namely sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting and "other issues." The assessment of risk (low, high, or unclear) is given based on the authors judgement. For nonrandomized studies, the Newcastle-Ottawa scale[20] was used to assess its quality which offers a star system for analysis (►**Table 2**). It offers a maximum score of nine stars across three domains including selection, comparability and exposure. A score of 9 is considered to be a low risk of bias, a score between 7 and 8 is considered medium

Table 1 Assessment of risk of bias of the randomized trials using the Cochrane Collaboration's Tool

Study (Year)	Bias	Study judgement	Support for judgement
Collis et al (2013)[11]	Random sequence generation (selection bias)	Low risk	Each participant selected a tag with a group allocation concealed
	Allocation concealment (selection bias)	Low risk	Group allocation concealed
	Blinding of participants and personnel (performance bias)	Unclear risk	No information given
	Blinding of outcome assessment (detection bias)	Unclear risk	No information given
	Incomplete outcome data (attrition bias)	Low risk	No missing data
	Selective reporting (reporting bias)	Low risk	All outcome data reported
	Other bias	Low risk	Similar baseline characteristics in both groups
Kemler et al (2012)[12]	Random sequence generation (selection bias)	Low risk	Table of random numbers used
	Allocation concealment (selection bias)	Unclear risk	No information given
	Blinding of participants and personnel (performance bias)	Unclear risk	No information given
	Blinding of outcome assessment (detection bias)	Low risk	Blinded from outcome assessor and surgeon
	Incomplete outcome data (attrition bias)	Low risk	No missing data
	Selective reporting (reporting bias)	Low risk	All outcome data reported
	Other bias	Low risk	Similar baseline characteristics in both groups
Jerosch-Herold et al (2012)[13]	Random sequence generation (selection bias)	Low risk	Central telephone randomization service
	Allocation concealment (selection bias)	Unclear risk	No information given
	Blinding of participants and personnel (performance bias)	High risk	Neither the treatment therapist nor the patients were blinded
	Blinding of outcome assessment (detection bias)	Unclear risk	No information given
	Incomplete outcome data (attrition bias)	Low risk	No missing data
	Selective reporting (reporting bias)	Low risk	All outcome data reported
	Other bias	Low risk	Similar baseline characteristics in both groups

Table 2 Newcastle-Ottawa scale to assess the quality of nonrandomized studies

Study (Year)	Selection	Comparability	Exposure
Glassey (2001)[14]	***	**	***

Note: * refers to the number of stars (see text for further details).

risk, and a score of 6 or lower is considered a high risk of bias.

Results

Literature Search Results

Through the online literature search and subsequent screening, the authors identified four studies which met the eligibility criteria (►**Fig. 1**).

The baseline characteristics of the included studies were summarized in ►**Table 3**.

Primary Outcomes

Range of Movement

The improvement in the range of movement was assessed in terms of TAF and TAE gained in degrees postoperatively for all studies at a 3-month follow-up period. TAF (►**Fig. 2**) was reported in three studies enrolling 241 participants. This was the mean flexion in degrees per finger gained for MCP, PIP, and DIP joints. Overall, the three studies included a total of 256 fingers as some patients had multiple digits operated on. There was no significant difference seen in the mean difference analyses comparing the two groups (MD = −11.28, 95% CI: −45.91 to 23.35, $p = 0.52$). A high level of heterogeneity was found among the studies ($I^2 = 90\%$, $p < 0.0001$).

The mean total active extension (►**Fig. 3**) gained in degrees per finger at 3 months postoperatively was reported in two studies enrolling 210 patients with a total of 215 digits. There was no statistically significant difference seen in the mean difference analyses comparing the two groups (MD = −2.88, 95% CI: −11.43 to −5.68, $p = 0.51$). A low level of heterogeneity was found among the studies ($I^2 = 0\%$, $p = 0.78$).

Disabilities of the Arm, Shoulder, and Hand Questionnaire

The differences in the DASH questionnaire scores pre- and postfasciectomy at 3 months were reported by Collis[11] and Jerosch-Herold.[13] There was no significant difference seen in the mean difference analyses (MD = −2.15, 95% CI: −7.29 to −3.00, $p = 0.41$). A low level of heterogeneity was found

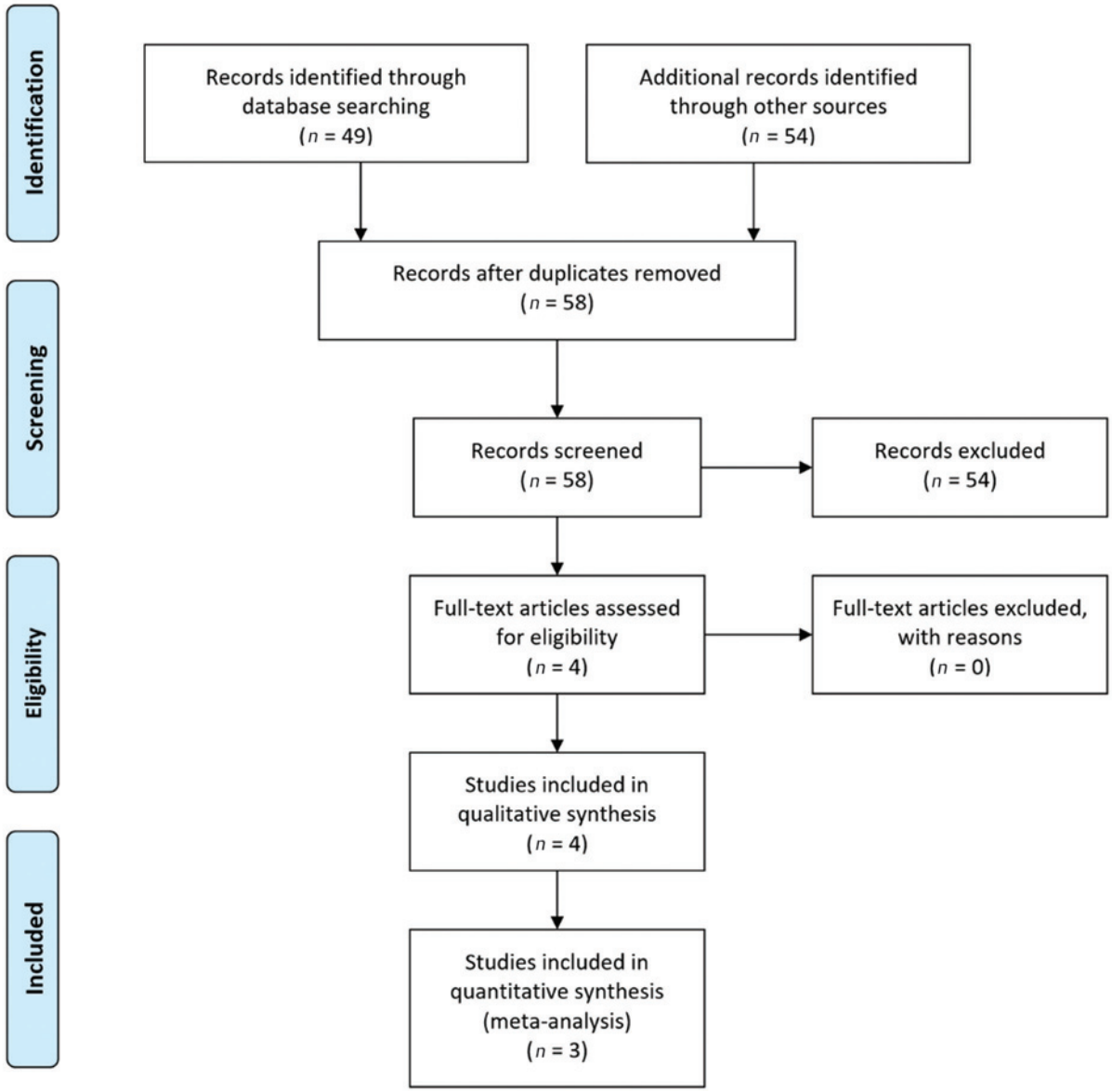

Fig. 1 PRISMA flow diagram, outlining the search and selection process for retrieved articles.

among the studies ($I^2 = 0\%$, $p = 0.97$). Collis reported a loss of three patients to follow up and Jeroch recorded two.

Glassey[14] also assessed hand function using the DASH questionnaire; however, only reported scores at 3 months therefore not allowing for a quantitative assessment of difference from baseline. According to Glassey,[14] there was a significant advantage to hand function in the nonsplintage group ($p = 0.01$) at 3 months.

Secondary Outcomes

Intensity of Pain

Kemler[12] and Glassey[14] both reported no significant difference between the two groups in terms of intensity of pain with both studies using a 10-cm visual analog scale (VAS) to assess intensity of pain. Kemler[12] assessed pain intensity 6 weeks after surgery (VAS = 2.1 ± 2.4 [hand therapy alone] vs. 1.9 ± 2.0 [hand therapy with splint]; $p = 0.7$), while Glassey[14] analyzed pain intensity after 3 months (difference = 105.0; $p = 1.00$).

Grip Strength

According to Collis[11] and Glassey,[14] both studies assessed grip strength using a Jamar dynamometer and analyzed the results with a Mann–Whitney U test. At 3 months post-treatment, Collis[11] reported no significant difference between the no orthosis and orthosis groups in the right hand (33 ± 13 [hand therapy alone] vs. 27 ± 12 [hand therapy with splint]; $p = 0.11$) and the left hand (30 ± 13 [hand therapy alone] vs. 25 ± 11 [hand therapy with splint]; $p = 0.19$). Similarly, there was no significant difference reported by Glassey[14] at 3 months (difference = 74.5; $p = 0.26$).

Table 3 Baseline Characteristics of the Included Studies.

Study (Year)	Study design	Total study sample (hand therapy alone: splintage and hand therapy)	Sex (male: female)	Mean age (hand therapy alone vs. Splintage and hand therapy)	Surgical intervention	Digits and joints	Criteria for "per protocol" splintage in hand therapy only group
Collis et al[11] (2013)	RCT	56 (30:26)	45:11	67 ± 9 vs. 68 ± 8 y	Fasciectomy: 50 Dermofasciectomy:6	Ring: 22 Middle: 13 Small: 43 (MCP and PIP joints)	Extension loss of greater than 20 degrees at PIPJ or 30 degrees at MCPJ compared to first postoperative visit ($n = 3$)
Kemler et al[12] (2012)	RCT	54 (26:28)	46:8	64 ± 11 vs. 63 ± 9 y	Fasciectomy: 54	NR	Nil
Jerosch-Herold et al[13] (2011)	RCT	154 (76:75)	120:34	67.5 ± 9.2 vs. 67.2 ± 10.0 y	Fasciectomy: 136 Dermofasciectomy: 16	Index: 8 Long: 23 Ring: 63 Small: 109 (MCPS and PIP joints)	Extension loss of greater than 15 degrees at PIPJ or 20 degrees at MCPJ at second postoperative visit ($n = 13$)
Glassey[14] (2001)	Retrospective study	31 (10:21)	25:6	58.5 ± 13.15 vs. 68.76 ± 7.62 y	Fasciectomy: 31	Fingers not specified (MCP, PIP, and DIP joints)	Not applicable

Abbreviations: DIP, distal interphalangeal joint; MCPJ, metacarpophalangeal joint; NR, not reported; PIP, proximal interphalangeal joint; PIPJ, proximal interphalangeal joint; RCT, randomized controlled trial.

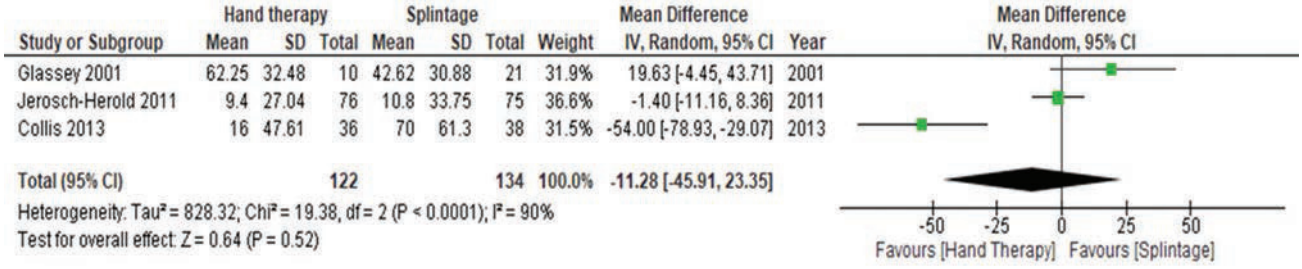

Fig. 2 Forest plot for hand therapy versus splinting (with hand therapy). Mean total active flexion gained in degrees per finger at 3 months post-Dupuytren's fasciectomy.

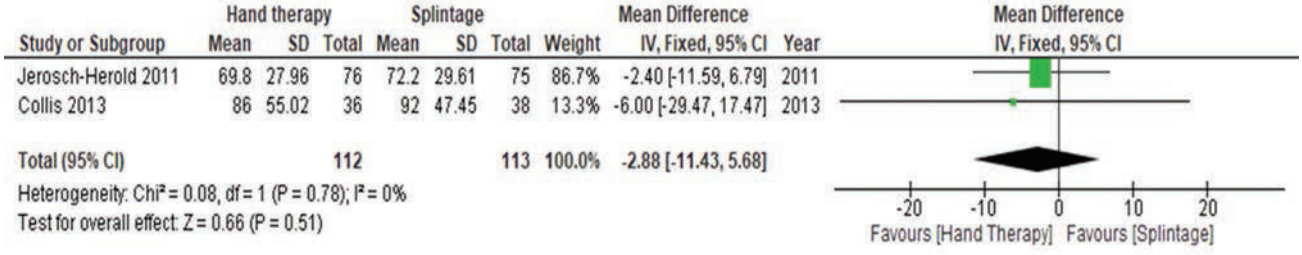

Fig. 3 Forest plot of hand therapy versus splinting (and hand therapy). Mean total active extension gained in degrees per finger at 3 months postoperatively. No significant difference identified with a mean difference analysis.

Global Perceived Effect

Global perceived effect is a numerical scale that is assessed by asking the patient to rate how much their condition has improved or worsened in a specified time.[21] According to Kemler,[12] there was no significant difference associated with the mean global perceived effect between both groups 1 year after surgery (19 [hand therapy alone] vs. 18 [hand therapy with splint]; $p = 0.5$).

Patient Satisfaction

Jerosch-Herold[13] used a scale of 1 to 10 for assessing patient satisfaction in which there was no significant difference 6 months after surgery between both groups (9.0 ± 1.23 [hand therapy alone] vs. 8.7 ± 1.89 [hand therapy with splint]; $p = 0.254$).

Methodological Quality and Risk of Bias Assessment

The quality assessment of the RCTs[11–13] included in the study was performed by using the Cochrane Collaboration's Tool as summarized in ►**Table 1**. Newcastle-Ottawa Quality Assessment Scale was used for Glassey,[14] a retrospective cohort study, showing high quality of selection, comparability, and exposure (►**Table 2**).

Discussion

Splints are commonly static, for ease of application and use, but they can be dynamic.[22] Dynamic splinting incorporates a mechanical adaptation to allow movement of the digits while ensuring maintenance of the joints at end-range at rest.[23] Static splinting involves using a dorsal or volar based splint that prevents movement of joints, ensuring stability, protection, and support in one particular position.[24] In a review in 1992, static splints were deemed to be a superior option in patients with Dupuytren's contracture.[7] However, Larson et al showed that dynamic splints could also improve the extension movement of the PIP joints in the long term.[4] The literature is debated and inconclusive. The splints in all the studies examined in this review were static.

The results of this study show that the use of a splint offers no advantage in improving outcomes when compared with hand therapy alone. TAF (►**Fig. 2**) and TAE (►**Fig. 3**) showed no improvement ($p = 0.52$ and $p = 0.51$, respectively) in the splint and hand therapy group compared with the control group. DASH scores did not show any differences between the groups (►**Fig. 4**). The heterogeneity among the studies was low for all the outcomes ($I^2 = 0\%$) apart from TAF which showed a high level ($I^2 = 90\%$), based on the assessment as reported in Section 2. All the other outcomes, including pain, grip strength, global perceived effect, and satisfaction, showed no significant differences between the two groups.

It is, however, important to note that both Collis et al and Jerosch-Herold et al had an option in the nonsplinted group of intervening with the addition of a splint. This emphasizes that the hand therapist must be involved in the care of postfasciectomy patients and should see the patient over a period of time, rather than a single postoperative review (or not at all), in case intervention with a splint is deemed necessary. Jerosch-Herold et al, at the second postoperative visit, intervened with application of a splint if there was net loss of 15 degrees or more at the PIPJ and/or 20 degrees or more at MCPJ. Collis et al took a similar approach providing participants in the nonorthotic group with a splint if they lost extension >20 degrees at the PIPJ, or 30 degrees at MCPJ compared to the first postoperative measurement. It was not possible to assess this subgroup of patients in this meta-analysis as the data were not presented separately. However, an element of what is often termed "recurrence" of Dupuytren's Disease postoperatively will likely be to scarring and joint contracture rather than true recurrence of the disease. Hence, it would seem reasonable to take the approach of these authors and intervene with splintage when a net loss is noticed at either the MCPJ or PIPJ at the second postoperative visit, in order to combat digital contracture.

A recent review article by Pashmdarfard et al recommends the combination of orthosis and hand therapy in postfasciectomy treatment for Dupuytren's contracture to be the most effective choice and advocates consistent splint use for controlling pain and preventing contracture.[10] However, the quantified outcome measures obtained in the current review suggests no difference to hand therapy alone. Splinting adds to the cost of treatment[9] in addition to taking up clinic time from hand therapists (local department estimate £5 per splint, and 15 minutes of therapist's time per patient). Such resources should be therefore used judiciously in order to minimize financial constraints on health services and it would seem sensible to reserve splints for an intention to treat basis when there is a net loss of extension postoperatively.

A systematic method was used in this evaluation to provide a conclusion of the best available evidence and to explore the risk of bias of relevant trials.[11–14] Based on the design and the populations studied, the three RCTs were standardized which makes the conclusions of this study robust from the best available evidence. However, the reported outcomes of the current review should be interpreted in the context of inherent limitations. Only four studies were identified consisting of 295 participants and the authors suggest more randomized trials to delineate further what the best rehabilitation protocol should be. In addition, outcomes should be reported more homogeneously over longer follow-up periods to enable a more robust analysis. Jerosch-Herold et al[13] assessed extension at 6 months postoperatively, whereas the other authors

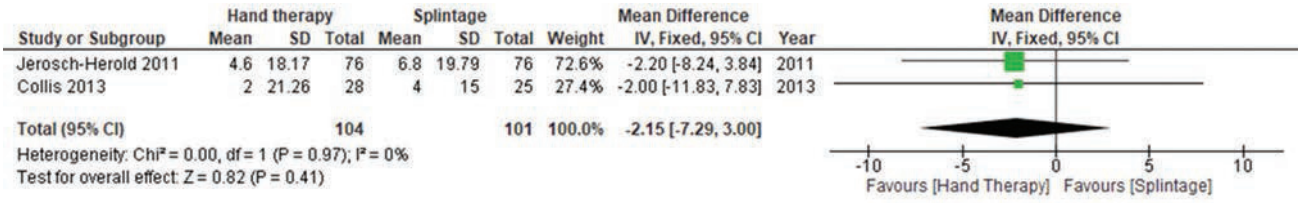

Fig. 4 Forest plot for hand therapy versus splinting (with hand therapy). DASH questionnaire. Quantitative analysis showing the mean difference in the DASH questionnaire reported by Collis (2013) and Jerosch-Herold (2011) from baseline to 3 months postfasciectomy. DASH, Disabilities of the Arm, Shoulder, and Hand.

reported three monthly outcomes in the quantified variables for DASH, TAF as well as TAE. We would suggest that the timescale of reporting outcomes should be standardized at 6 months to ensure maintenance of extension.[25]

Conclusion

The findings of this review indicate that the addition of splintage adds no functional benefit when used in combination with hand therapy postfasciectomy for Dupuytren's contracture. However, close therapy-led follow-up of these patients is important, and there may be a role for the use of splinting in certain patients who appear to be deteriorating at after their initial postoperative review. The authors advocate judicious use of orthotic regimes as it adds to cost of treatment and should be reserved on an intention to treat basis only with development of an extension deficit postoperatively.

Author Contributions
M.K., N.K., and A.A. contributed equally as first joint authors in the acquisition, statistical analysis, and interpretation of data as well as drafting the manuscript. S.R. and R.P. were responsible for study concept, design, and supervision. All authors read and approved the final manuscript.

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Conflict of Interest
None declared.

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