Orthopaedics & Traumatology: Surgery & Research 105 (2019) 1187–1191

Contents lists available at ScienceDirect

Orthopaedics & Traumatology: Surgery & Research

journal homepage: www.elsevier.com

Original article

External fixation: Role in decreasing postoperative complications of complex syndactyly release – A review of 18 patients

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ARTICLE INFO

Article history:
Received 15 April 2018
Accepted 8 May 2019

Keywords:
Complex syndactyly
Dressing
External fixator
Postoperative care

ABSTRACT

Background: Primary and revision surgery for complete complex congenital syndactyly (CCCS) of the hand carries a risk of complications such as web maceration, which can result in flap or graft loss and alter the final appearance. No consensus emerges from the scant published data on postoperative care after CCCS surgery. The objective of this study was to assess the role for temporary external fixation in stabilising the commissure and facilitating surgical wound care.
Hypothesis: Using external fixation after CCCS release facilitates postoperative wound care and decreases the complication rate.
Material and methods: Eighteen patients requiring primary CCCS surgery or revision CCCS surgery due to adhesions or web creep were included in a single-centre retrospective study. After release, an external fixator made of Kirschner pins was installed to temporarily immobilise the inter-phalangeal joints. The dressing was changed every 3 days for 3 weeks, and the external fixator was then removed. The parents and nurses completed questionnaires that used 0–10 point scales to assess ease and duration of dressing changes and perceptions and apprehensions experienced by parents and nurses, as well as pain by patients, during dressing changes.
Results: No patient experienced maceration or failure of a graft or flap. Pin site discharge was noted in 1 patient and resolved fully after pin removal. Pain intensity was estimated at 4.2/10 during the first dressing change and 1.3/10 during the last dressing change. In the parents, apprehension was 9.6/10 and 5.1/10 during the first and last dressing changes, and stress was 8.1/10 and 4.1/10, respectively. Dressing change difficulty was rated 1.1/10 at the first and 0.9/10 at the last dressing change. Dressing change duration decreased from 13 to 10 minutes.
Conclusion: These encouraging results support temporary commissure stabilisation by an external fixator to decrease postoperative complication rates and facilitate dressing changes after CCCS release.
Level of evidence: IV, retrospective observational study.

1. Introduction

Complete complex congenital syndactyly (CCCS) is defined as fusion of two or more fingers along their full length with more or less extensive nailfold and/or bone fusion [1–4]. Primary and revision surgery carries a high complication rate of 5.2% to 25% [5–7]. Postoperative complications consist of maceration, web creep, surgical-site infection, and local flap or skin graft necrosis.

The surgical management of syndactyly is well standardised [8–13] in terms of incision design and use of skin grafts and local flaps. In contrast, regarding postoperative care, no consensus emerges from the scant published data [8,9,12,14,15]. We hypothesised that temporary external fixation of the digits and commissures might prove beneficial.

The objective of this study was to assess the role for temporary external fixation in stabilising the commissure and facilitating surgical wound care. The working hypothesis was that external fixation after CCCS release facilitates postoperative care and decreases the complication rate.

2. Material and methods

2.1. Study patients

This single-centre retrospective study included 18 patients (10 boys and 8 girls) who underwent CCCS surgery between January

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https://doi.org/10.1016/j.otsr.2019.05.015
1877-0568/

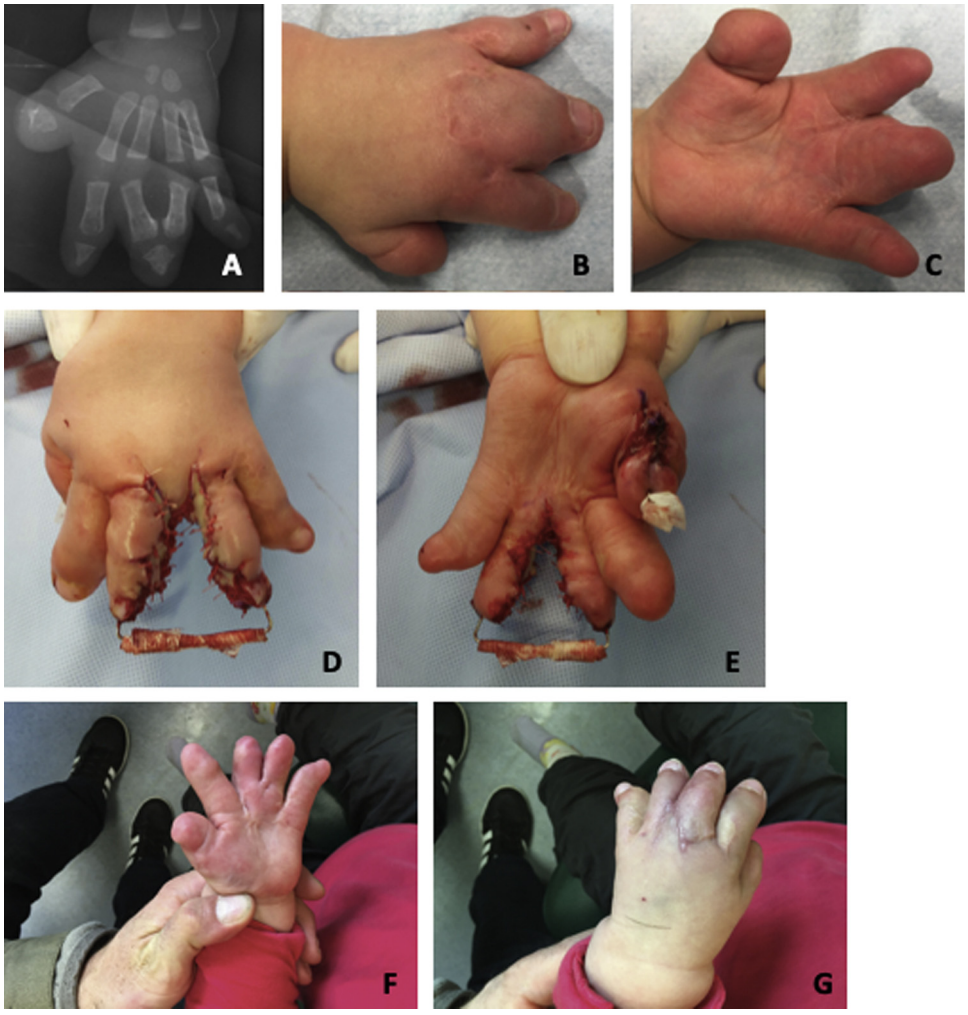

Fig. 1. Release of the third web space in a patient with Apert syndrome. A. Radiographic appearance. B and C. Clinical appearance before surgery. D and E. Clinical appearance immediately after surgery. F and G. Clinical appearance 4 weeks after surgery.

2016 and October 2017. Among them, 14 had a single CCCS and 4 had two CCCSs each, for a total of 22 CCCSs. Mean age at surgery was 14 months (range, 6–36 months; median, 12.5 months) and mean follow-up was 13.3 weeks (range, 3–41 weeks; median, 10.5 weeks). Primary surgery was performed in 13 patients and revision surgery in 5 patients. The reason for revision surgery was local maceration with skin graft and/or local flap loss in 3 patients and web creep in 2 patients. We did not study patients with simple or incomplete syndactyly, which are associated with lower postoperative complication rates and do not routinely require skin grafting.

Of the 18 patients, 8 patients had genetic multiple malformation syndromes, including 5 with Apert syndrome and 3 with Poland syndrome. These 8 patients and another patient had severe bone abnormalities including hypoplasia of the hand, delta phalanx, missing phalanx, and extensive synostosis.

Informed consent to use of an external fixator was obtained from the parents before surgery. The parents were given information on the appearance and size of the external fixator, with photographs, and on the postoperative care and follow-up modalities.

In each patient, the surgeon performed a clinical and radiological evaluation of the hands. Patients with multiple malformations were evaluated by a multidisciplinary team. All patients received follow-up from the same surgeon. Wound care was given by surgical nurses at the hospital outpatient clinic.

2.2. Surgery and postoperative care

Syndactyly release was achieved by Cronin zigzag incisions with creation of a dorsal commissural omega flap [12]. A Buck-Gramcko [16,17] flap was used when nailfold reconstruction was required. A full-thickness skin graft was harvested from the anterior aspect of the wrist or, more rarely, the groin. Surgery was performed with a tourniquet applied to the arm and inflated to twice the patient's systolic blood pressure; the tourniquet was released before graft implantation and wound dressing.

Once release was achieved, the proximal and distal interphalangeal joints of the two fingers involved were immobilised using 10/10th Kirschner pins inserted using a Jacobs chuck. The pins were bent and connected to each other to spread and immobilise the fingers (Figs. 1 and 2). The dressing was fashioned at the end of the procedure by applying an anti-adhesive silicone interface followed by gauze pads and, finally, by a crepe bandage. No radiographs were taken at this point. Analgesics consisted of ibuprofen and paracetamol in dosages adjusted for body weight, for 3 days and 21 days, respectively.

The dressings were changed at the hospital outpatient clinic twice a week, in the presence of the parents, for 3 to 4 weeks depending on the pace of wound healing. The surgeon re-evaluated each patient once a week. The dressings were changed by the outpatient nurses, who had not received specific training for this type of wound care and were instructed to follow prescriptions for wound

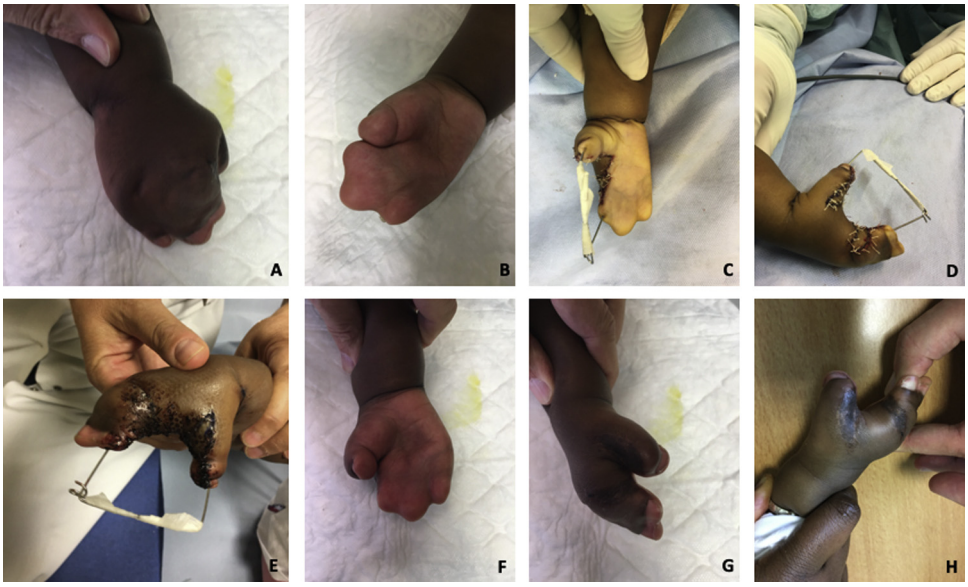

Fig. 2. Release of the first web space in a patient with Apert syndrome. A and B. Clinical appearance before surgery. C and D. Clinical appearance immediately after surgery. E. Clinical appearance 2 weeks after surgery. F–H. Clinical appearance 4 weeks after surgery.

Table 1
The FLACC Pain Assessment Tool.

Face	0 No particular expression or smile
	1 Occasional grimace of frown, withdrawn, disinterested
	2 Frequent to constant frowning, clenched jaw, quivering chin
Legs	0 Normal position or relaxed
	1 Uneasy, restless, tense
	2 Kicking or legs drawn up
Activity	0 Lying quietly, normal position, moves easily
	1 Squirming, shifting, back and forth, tense
	2 Arched, rigid, or jerking
Cry	0 No cry (awake or asleep)
	1 Moans or whimpers, occasional complaint
	2 Crying steadily, screams, sobs, frequent complaints
Consolability	0 Content, relaxed
	1 Reassured occasionally by touching, hugging, or being talked to, distractible
	2 Difficult to console or comfort

care supplies (which were identical to those used in the operating room). The patients were to take the analgesics 1 hour before the dressing change. The surgeon used forceps to remove the pins 21 days after the surgical procedure.

Once the wound was healed, the parents were to apply a moisturising cream (glycerol, paraffin, and petroleum jelly) to the hands for 2 weeks. Rehabilitation was via spontaneous activity, stimulated if needed by playing. The patients were re-evaluated every 2 months.

2.3. Study data collection

The study data were collected by having the parents and nurses complete self-administered questionnaires at each dressing change (Appendix B). The items were developed with the hospital psychologist and rated on a scale of 0 to 10.

Pain experienced by the patients during the dressing changes was assessed by the nurse using the FLACC (Face, Legs, Activity, Cry, Consolability) Pain Assessment Tool [18] (Table 1).

At each dressing change, the wounds were examined for local maceration or infection and for necrosis of a flap or graft, which were recorded.

3. Results

The total number of dressing changes was 113, yielding a mean of 6.3 per patient. Mean time needed to change the dressing was 13 minutes (range, 10–16 minutes for the first dressings) and 10 minutes (range, 7–13) for the last dressings. No patient was lost to follow-up.

No patient experienced maceration or failure of a local flap or graft.

A single patient experienced a complication, consisting in a skin reaction (erythema and clear discharge) 16 days postoperatively at a pin entry site. The symptoms resolved fully after pin removal, without antibiotic therapy.

Table 2 reports the data on pain intensity as assessed using the FLACC tool. Mean pain intensity was 4.2/10 for the first dressing and diminished thereafter to 1.3/10 for the last dressing. No patient required equimolar oxygen/nitrous oxide during the dressing changes. The data on the other questionnaire items also show marked improvements from the first to the last dressing change (Table 2).

4. Discussion

The use of external fixation in the study patients was effective in preventing postoperative complications, confirming the working hypothesis.

Wound care is a key component of the postoperative program for patients with complete congenital syndactyly, notably those with complex forms, in whom the complication rate exceeds 5%. However, few published studies have described wound care after CCCS release [8,9,12,14,15].

We initially reserved external fixation for patients undergoing revision CCCS surgery. These patients already had experience with conventional postoperative wound care. The outcomes were favourable and the parents reported marked improvements in early postoperative care and levels of pain during dressing changes compared to the primary procedure. We therefore decided to use external fixation routinely after CCCS surgery.

Our decision to reserve external fixation for patients with CCCS (including patients with multiple malformation syndromes) was based on the complication rates reported by McQuillan [5] (5.2% in

Table 2
Results of the questionnaires and FLACC scale.

	First dressing changes		Last dressing changes	
	Mean	Range	Mean	Range
Pain	4.2/10	1–7	1.3/10	0–3
Anticipatory anxiety experienced by the parents	9.6/10	9–10	5.1/10	3–6
Perceptions reported by the parents	8.1/10	4–10	4.1/10	0–7
Anticipatory stress experienced by the nurse	1.1/10	0–4	0.3/10	0–2
Difficulty	1.1/10	0–3	0.9/10	0–2
Procedure duration (minutes)	13	10–16	10.2	7–13

patients with CCCS vs. 2.3% in those with simple syndactyly within 30 days after surgery), Bulic [6] (12%), and Barabas and Pickford [7] (25%). In patients with multiple malformation syndromes, CCCS is often associated with severe bone malformations that require extensive skin grafting and complex local flaps. External fixation was therefore warranted to ensure optimal graft and flap survival by improving wound aeration and by decreasing maceration and shear forces.

The dressings were changed twice a week in our study. Criticism has been directed at frequent dressing changes, albeit without any supporting evidence [8,9,12,14,15]. The high rate of maceration seen when the dressing is not changed, or when casting is used for immobilisation, warrants frequent dressing changes. The specific histological characteristics of the paediatric skin, [19] including greater exudation and sweating and a higher pH compared to adult skin, require wound care at shorter intervals. We recognise, however, that the need to go to the hospital twice a week for dressing changes places a burden on the families, and we believe that changing the dressing once a week would have no adverse impact on the surgical outcomes. Furthermore, we feel that community nurses could provide the wound care needed after CCCS release, after receiving limited training consisting simply in providing the parents with a written document describing the procedure.

The questionnaire data showed that the anticipatory anxiety experienced by the parents decreased from one dressing change to the next. The nurses described the technical aspects of the procedure as simpler and faster. The data on pain intensity obtained using the FLACC tool established that the use of an external fixator contributed to diminish the level of pain.

None of the patients experienced maceration, web creep, graft loss, or flap necrosis, and none required revision surgery.

This work was a pilot study in a small number of patients. Consequently, no statistically significant differences can be demonstrated.

External fixation has been used previously after syndactyly release in patients with epidermolysis bullosa (Chevaleraud et al. [14]) or burn scars (Kamath et al. [15]). The external fixators were bulkier than the ones used in our patients. Both study reports describe decreased maceration rates and virtually no infections, although no numerical data are provided. The external fixator described here is used only in paediatric patients and is smaller and readily accepted by the families. Our study is the first to provide numerical data on outcomes after using external fixation for postoperative CCCS care.

It has been suggested that the dressing should not be changed for the first 2 to 3 weeks [8,9]. The dressing is made of a silicone interface overlain with woven gauze pads and, in some cases, by a protective cotton layer reinforced by cast immobilisation. The studies report no clinical or numerical data and did not select specific types of syndactyly. In paediatric patients, irrespective of whether cast immobilisation is used, leaving a dressing unchanged for 3 weeks carries a high risk of maceration and may result in delayed wound healing or even in local infection or failure of the procedure requiring revision surgery. On the other hand, changing the dressing too often may result in shear forces being applied when the child moves, potentially causing a flap or skin graft to detach.

Postoperative care after CCCS release requires specific precautions. External fixation can facilitate this phase of patient management.

5. Conclusion

The data reported here support the use of external fixation after CCCS release as a means of decreasing pain intensity, facilitating wound care, and preventing postoperative complications. External fixation prevents maceration by spreading the fingers and prevents complications such as graft loss, flap necrosis, and web creep. We reserve external fixation for selected patients. However, we believe that external fixation should be considered when the risk of postoperative complications is high. Further studies are needed to assess long-term outcomes.

Disclosure of interest

The authors declare that they have no competing interest.

Funding

None.

Contributions

Mickaël Artuso contributed to design the study, collected and analysed the data, occasionally assisted in the surgical procedures, wrote and revised the manuscript, and handled correspondence with the OTSR editorial board.

Virginie Mas contributed to design the study, collected and analysed the data, and regularly assisted in the surgical procedures.

Brice Ilharreborde contributed to design the study and supervised the conduct of the study.

Keyvan Mazda contributed to design the study and supervised the conduct of the study.

Pascal Jehanno contributed to design the study, collected and analysed the data, was the main surgeon, supervised the conduct of the study, and contributed to write and revise the manuscript.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at: https://doi.org/10.1016/j.otsr.2019.05.015.

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