RESULTS OF SURGICAL AND POSTOPERATIVE TREATMENT OF SYNDACTRYLY IN EPIDERMOLYSIS BULLOSA

BARTŁOMIEJ NOSZCZYK1, JOANNA JUTKIEWICZ2, JÓZEF JETHON1,
MIROSŁAW WRÓBEL2, PIOTR SZOPIŃSKI3

Department of Plastic Surgery, Medical Centre of Postgraduate Education in Warsaw1
  Kierownik: prof. dr. hab. J. Jethon
Department of Pediatric Surgery, Prof. Bogdanowicz Memorial Hospital in Warsaw2
  Ordynator: dr med. M. Wróbel
Department of General and Vascular Surgery, Medical University in Warsaw3
  Kierownik: prof. dr hab. P. Ciostek

Use of small autologous skin grafts or leaving the defects and waiting for their spontaneous reepidermolization are one of the methods of wound management after surgical treatment of hand contractures in Epidermolysis bullosa. This technique is believed to allow quick wound healing, however this does not seem universally possible.

The aim of the study was to assess healing rate and incidence of early recurrence after using of both techniques.

Material and methods. Eleven operations of hand contracture were performed, including two recurrent cases after previous surgeries. Skin grafts were used in eight cases. Kirshner wires were not used and the fingers were stabilized in an extended position only with a supportive dressing. In the early postoperative period, dressings were made in the operation room and patients were admitted for 24-hour hospitalizations no more than once a week.

Results. Complete healing before day 35 was achieved only in five cases. In the remaining cases, dressings in the operating room were abandoned between day 35 and 40 and the patients were referred to further treatment in the outpatient setting. In the early postoperative period, dressings were made in the operation room and patients were admitted for 24-hour hospitalizations no more than once a week.

Conclusions. Our results indicate that the postoperative wound healing does not depend on the use of skin grafts and can be much longer than some previous studies suggested. This shortens the period of full efficiency between the recurrences. Clinical observations also indicate that this affects the risk of early recurrences. Despite that, their number is similar to the value considered good in the literature.

Key words: dystrophic epidermolysis bullosa, hand surgery, pseudosyndactyly, hand contractures, scarring, deformities, skin grafts, poor healing, dressings, recurrence

Annually at least 15 children are born who are affected with Epidermolysis bullosa dystrophica (EBD) in Poland (1). Probably only some of these patients attend dermatologists who qualify them to attempts of medical treatment. Only negligible number of patients receive surgical therapy, since Polish literature reports only 1 such case (2). However it is one of few skin diseases of genetic etiology where surgical treatment results in periodic improvement, giving the child an opportunity of normal development and education. The disease is caused by mutations of COL7A1 gene, encoding type VII collagen. In healthy tissues this protein forms fibrils that anchor epithelia and their basement membranes, resulting in their stable adhesion to the background tissue. Its deficit contributes to epithelial damage, manifesting as epithelial desquamation and formation of blisters and wounds at even the slightest
trauma. Most often the wounds are formed on hands and feet and continuous healing leads to scars resulting in contractures and pseudo-syndactyly as early as in the early childhood. The progressive contractures of the fingers ultimately form the hand into a cocoon and short muscles and digit bones become atrophic.

The surgical treatment involves periodic release of the contractures and separation of syndactyly. It requires preparation or experience because high risk of trauma often contributes to serious iatrogenic injuries. Hard and keratinous epidermis can desquamate over the whole surface of the hand, far from the surgical area, and low skin elasticity makes standard plasty difficult. Although autologous dermatome grafts are sometimes used, however their value is a matter of debate because usually they cannot be harvested without epidermal desquamation. The requirement of proper management of extensive wounds is a problem in such situations. The most common method is to leave the naked surfaces of the dermis until it is spontaneously covered by epidermis. Slight autologous full thickness grafts are used only at the sites of exposed tendons and vasulonervous fascicles (3).

Because the disease is of genetic etiology, recurrences of lesions are typical and their incidence is similar irrespective of the type of operation. In such situation time during which a child achieves complete mobility after the treatment, is crucial here. Any errors or additional injuries that prolong treatment, decrease efficiency period which ultimately raises doubts over feasibility of this procedure. We present a method of treatment that is used at the site of the authors and is the most commonly recommended one, including as seldom dressings as possible, over a relatively long period of time that elapses until complete wound healing. Modifications introduced by authors led to treatment improvement and allowed to prolong the time between subsequent operations as much as to two years. Despite good long term results it has been concluded that the presented techniques prolong healing and they require further improvement.

MATERIAL AND METHODS

Patients

Systematic operations in EBD patients were started in June 2005, after a cooperation with Clinic of Dermatology, Warsaw Medical University, was established. This Clinic had a stable group of approximately 15 patients with EBD. By the end of December 2006, 6 hands of 3 patients underwent 7 operations, including one reoperation due to recurrence on the right side. In the early 2007, the program was suspended due to administrative changes in the hospital. Another operations were started since December 2007 in Prof. Bogdanowicz Voiodeship Pediatric Hospital in Warsaw. By the end of March 2008, 4 hands of 3 patients underwent 4 operations, including one patient who underwent operations due to bilateral recurrences after operations performed in 2005 and 2006. A total of 8 hands in 5 patients underwent 11 operations.

Surgical technique and hospital dressings

A technique was used without skin grafts or with small, full thickness skin grafts, as described previously (1). Surgical treatment was performed under general anesthesia and subsequent dressings under brief intravenous anesthesia, without additional regional anesthesia and without ischemia, thus abandoning plasters. Special care was taken to avoid epidermal injuries outside the operative area and attention was also paid to the behavior of the remaining personnel of the operation room. The operation was started by so called degloving maneuver, from superficial section in the metacarpus, to the periphery of the thenar. The sectioned epidermis is taken off the hand like a one-fingered glove and the smooth surface of the dermis is exposed (fig. 1).
After the skin exposure, the pseudosyndactyly between fingers II-V was separated. The surfaces of the dermis of the fused fingers do not form a completely homogeneous structure. In such situations, finger separation requires localization of the proper layer that allows blunt preparation. The fingers were separated to the level that was slightly peripheral to metacarpophalangeal (MP) joints. Syndactyly resection facilitated assessment of true finger length and localization of interphalangeal joints. This allowed to plan sections to release scars resulting in contractures, precisely in flexion grooves of the proximal interphalangeal joints (PIP) and distal interphalangeal joints (DIP). Sections in the dermis were performed in transverse direction on the palmar surfaces and were continued to the lateral surfaces of the fingers. Finger extension was usually accompanied by exposure of the flexor sheath at the region of PIP joint plate. During this maneuver, special care was taken to avoid injury of tendons and vasculonervous fascicles. Complete extension of distal digits was considered unnecessary when long standing contracture led to DIP joint changes that were difficult to reverse. Extended digits were not stabilized: they were only supported in the extension by a proper dressing.

Complete adduction contracture thumb was present only in the most fused hands (fig. 2). More often the syndactyly involved only the surface to the level of the interphalangeal joint (IP) of the thumb, enabling limited movements in the joint. Finger abduction universally required extensive and deep preparations up to the surface of the adductor muscle of the thumb. Small autologous full thickness skin grafts, harvested from the groin or shoulder, were apposed on the exposed muscle surface, similarly as on the exposed flexor sheaths or vasculonervous fascicles (fig. 3).

During the graft harvesting or implantation usually epidermis was detached from their surface. Despite that, in majority of cases of grafts were used (in 8 out of 11 operations). Grafts were abandoned only when an exposed subcutaneous tissue covered the deeper structures, providing adequate protection. Grafts were not used on the remaining hand surface and the dermis was left to undergo spontaneous epidermization.

Thin layers of silicone were used in the dressings, covering the whole wound surface like a glove (fig. 4a-c). This prevented early fusion of interdigital spaces. Usually silver dressings were used on the silicone layers and absorbing sponges and self-adhesive bandage were apposed that facilitated maintenance of extended fingers (fig. 4d-f). A dressing performed on the day of the operation (first dressing) was left unchanged for approximately 2 weeks. Subsequently old dressings were removed with utmost care, to avoid damage of the healing surfaces. They were removed after the hand was soaked in a container with betadine solution. Subsequent dressings were performed under intravenous anesthesia in an operating room, as previously. Patients were admitted to the hospital for a short, 24-hour hospitalization. The dressings were managed until the wound healing, every 7 days or slightly less often, depending on the level of infection. The
Fig. 4a. A sponge band over the wrist and silicone thin layer covering the hand after formation of finger holes. Additional silicone strap evident in the first interdigital space.

Fig. 4b. A sponge in the first interdigital space to abduct the thumb.

Fig. 4c. Bands of silicone thin layer forming tubes and placed between the fingers. Separate sutures attach the tubes to the wrist band.

Fig. 4d. Sponge straps placed between the fingers to separate them. The straps are fixed with sutures that attach them to sponges on both hand surfaces.

Fig. 4e. Stabilizing sponges on both hand surfaces. The sponges are attached on their margins and reinforced with sutures between the fingers.

Fig. 4f. A dressing on the palmar side of the hand, reinforced with a gauze and self-adhesive bandage.
healing required even 4 such procedures besides the one performed during the operation. In advance contractures, the whole cycle of hospital dressings usually took up to 40 days.

Outpatient dressings

Following complete wound healing, the subsequent visits were performed in an outpatient setting. A thermoplastic splint with silicone gel leaflets to separate fingers, was done at the first follow-up visit. The patients were advised to use this splint at night and as often during the day as possible during the first weeks. Parents were encouraged to undertake their own attempts to adjust the splint shape to their child’s needs (fig. 5).

In some patients complete healing was not achieved despite dressings performed in the operating room. All these patients were switched to an outpatient setting to avoid further anesthesia. In such cases tight dressings were abandoned and parents were advised to continue using thin silicone layers to prevent fusion of non-healed spaces between fingers (fig. 5) and to wash hands often in betadine solution or potassium permanganate. Parents, through their experience, are usually well prepared to manage blisters and wounds. Weekly outpatient follow-up was continued until the complete wound healing. Thermoplastic splint with finger separators (fig. 5) was prepared at the first or second visit. After the wounds healed, the patients were referred to a cooperating Department of Rehabilitation.

RESULTS

Lesion recurrences

In the group of 3 patients treated until August 2006, the lesion recurrence that required reoperation was observed in one patient. His right hand was reoperated within one year of the first operation. In the group of patients treated in 2008, bilateral lesion recurrences were observed in one patient who had been treated previously for the recurrence on the right side. The right hand was operated third time one year and 3 months after the first reoperation. His left hand was operated again after 2 years and 7 months. In the remaining patients, despite first symptoms of hand contractures within a year after the operation, they only had relative indications for treatment. One of these children has a scheduled operation.

Postoperative healing

The dressings performed during the operation (first dressings), were usually soaked with small amount of blood despite the use of absorbing sponges. The clotted blood in the sponges provided additional stabilization which was considered beneficial. When second dressings were performed, in week 2 after the operation (tab. 1), there were clinical evidence of wound infection such as unpleasant smell and amount of small amount of necrotic tissue. Epidermal migration could be spotted on the exposed surface of the dermis. Third dressing was usually performed on day 7 after the previous one (tab. 1). At this time, majority of wound surfaces were covered with an immature delicate epidermis that covered a bright pink or pale pink surface. Such wounds were considered healed. Small granulating defects appeared only in the interdigital spaces or at the sites of accidental damages done during the previous dressing. At this stage some patients were referred to an outpatient care despite incomplete healing of some wounds (tab. 1). During the fourth and fifth dressings, areas of granulation between the fingers and on the dorsal hand surface were still observed in some patients (fig. 6a). The latter were regarded as not complicating the further therapy and such hands were considered healed (tab. 1). In the remaining patients, clear maceration of the renewing epidermis and growing amount of necrotic tissues despite another week of healing,
Table 1. The table presents use of full thickness skin grafts, interval between dressings performed in an operating room, healing time and cases of early recurrences.

(Outpat.) – referred to an outpatient department with incompletely healed wounds

<table>
<thead>
<tr>
<th>Operation number</th>
<th>Patient and operation and 1st dressing date</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; dressing</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; dressing</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; dressing</th>
<th>5&lt;sup&gt;th&lt;/sup&gt; dressing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd dressing</td>
<td>right</td>
<td>left</td>
<td>right</td>
<td>left</td>
</tr>
<tr>
<td>1</td>
<td>WS – 20/06/2005</td>
<td>11</td>
<td>11</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WS – 24/11/2005</td>
<td>11</td>
<td>7</td>
<td>(outpat.) partial recurrence after 3 months</td>
<td></td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>OO – 20/10/2005</td>
<td>11</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>OO – 16/02/2006</td>
<td>11</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DZ – 27/03/2006</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>DZ – 20/07/2006</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>WS – 21/12/2006</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>healing without grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>WS – 21/12/2007</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>KC – 8/02/2008</td>
<td>15</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>full thickness grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>BK – 7/03/2008</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>healing without grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>WS – 28/03/2008</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>healing without grafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>13,3</strong></td>
<td><strong>12</strong></td>
<td><strong>7,5</strong></td>
<td><strong>7</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>
did not seem to favor further improvement (fig. 6b). On day 40 at the latest, a decision was taken to abandon treatment in the operating room and refer the patients to an outpatient setting despite granulating surfaces between the fingers.

The crucial item of subsequent outpatient treatment was cooperation with parents and their inclusion in the further management. Despite that, complete healing required another one to five weeks in all non-healed cases. It worsened the final result of treatment in two hands. Early, partial syndactyly, involving mainly I and V interdigital spaces were observed in such cases (fig. 6c).

**DISCUSSION**

Patients with dystrophic Epidermolysis bullosa suffer from scar-induced contractures and syndactyly that require surgical treatment and result from continuous wound healing. Although the operation usually brings temporary improvement, allowing the child to function normally at school and at home, however it is brief, seldom exceeds two years (4). Another lesions that limit hand and finger movements are indication for another surgical procedures. In the meantime the child usually requires operation of contralateral hand, thus essentially maintaining continuous contact with a hospital. Thus it is essential to minimize the treatment burden and complete it quickly, to avoid shortening of efficiency period. The emphasis is placed on limitation of the number of dressings under anesthesia and avoidance of iatrogenic injuries: treatment consequences and its unintended result. Harvest of autogenic grafts of intermediate thickness leaves extensive wounds both on the graft and in the whole harvesting area, resulting from the epidermis damage caused by bleeding under the basement membrane and manipulation with instruments. Use of stabilizing Kirschner wires causes joint injuries, that hamper and prolong already complicated rehabilitation. Thus it is best to abandon both these techniques, which sometimes impairs and probably prolongs postoperative treatment.

The operation results in extensive wounds of variable depth that are difficult to manage. Solutions of this problem include small autogenic full thickness grafts that leave most of the wound surface uncovered and allogenic skin constructs of various structure and origin. Treatment of postoperative wounds with small full thickness grafts is an established method (3). Although it does not protect the grafts from damage at harvesting, however allows covering of the exposed nerves, vessels and tendons, leaving only a short scar at the harvesting site.
In the described technique, small autologous full thickness grafts were used in majority of cases; such management was considered the most effective. Among three cases in which grafts were abandoned at all, two did not result in complete healing within 28 days of treatment. However, this may not indicate unfavorable course of treatment without grafts. Healing of spaces between fingers was found in both these cases which was essential to prevent early recurrence. Reliable evaluation of both techniques would seem to require larger sample size. German authors have already indicated that there is no need to use grafts (5, 6) which seems to support the existing doubts. Even small autologous grafts require harvesting from a region without any wounds or blisters, leaving scars and making subsequent choice of such site more difficult.

Among eight hands treated with grafts, two were operated at the beginning of the program in a fist qualified patient. In both cases only 3 dressing were performed in an operating room and the patient was referred to further outpatient care. This was probably an erroneous decision that ultimately led to an early recurrence on the right side. This complication required reoperation as soon as after one year. However, the left hand, treated in the same way, was healed within a subsequent week and remained efficient for two and half years which is difficult to explain. It probably resulted from less advances lesions before the operation and effective assistance of parents in the period of outpatient treatment. Three out of the six remaining cases ultimately led to complete healing in week four and five after the operation. Three hands in three consecutive patients treated with grafts, did not completely heal despite five hospital dressings. However the decision to refer these patients for further outpatient treatment seems justified. Probably too long maintenance of tight dressings facilitates gradual worsening of the local condition. This could be caused by repeated injuries resulting from a reaction to pruritus, maceration of migrating epidermis and accumulation of necrotic tissue which is difficult to remove. Change of management and frequent wound washing with an antiseptic and dressings that expose already healed surfaces, seems to facilitate the further course of healing. However, it is very difficult to prevent early syndactyly that repeated once again in one patient.

Healing without grafts or using small full thickness grafts requires at least 30 days of treatment. Even after this time, some wounds are only covered with a very thin epidermal layer over the clearly pink surface of the dermis. No evidence of exudation, bleeding or granulation is a criterion of healed wound, but even a very delicate contact with a dressing can cause a new defect, however it is not necessary threatening for the ultimate treatment result. Small granulating wounds on the palmar or dorsal surface impair subsequent rehabilitation but do not seem to directly affect recurrences of syndactyly. However, presence of granulation on contralateral finger surfaces and interdigital folds causes early complications. These areas may take long to heal and outpatient or home care do not completely prevent finger fusion and contractures. Thus preferentially these sites should heal during the period of dressings performed in the operating room, which is sometimes impossible. In our material, only five out of eleven cases ended in complete wound healing before day 35 (including one after the first outpatient dressing). It is worse scenario than described by a German team in patients treated without grafts who found 7 out of 7 treated hands healed within 4 weeks (5). A group of eight cases treated without grafts by a Spanish team was also healed within 35 days, with daily outpatient dressings (7). These differences may result from unequal lesion advancement before treatment, different criteria of healing or different dressing techniques, because it is difficult to believe that healing without grafts may occur faster than when they are used.

Established American authors did not assess the healing rate in the group of nine operated hands using full thickness grafts, emphasizing rather prevention of early recurrence. They found it in two mild patients and three moderate patients within a year after the operation (8). In a large group of 45 patients and 80 operated hands using grafts, an English team observed recurrences within one after the operation in 13.3% of patients (9). On the other hand, an American team investigating 110 operations in 25 patients, did not recommend the grafts since in their opinion that had no effect on prolongation of efficiency period. Only one postoperative dressing was performed in an operating room, after 7-10 days and patients were discharged and advised to undertake exer-
cise and further care at home. With the mean interval 2.2 years between the operations, early corrections occurred as early as after 6 months. Despite that the authors did not modify their management before achieving healing (10). Two early partial syndactyly recurrence were found in the study group (18%), but without contractures. These lesions seemed to be a consequence of incomplete healing of the interdigital spaces and failure in the further outpatient care.

It is possible that the problem of early recurrences resulting from fusion of non-healed interdigital spaces could be solved with artificial skin preparations. Their availability allows them to be used both during the operation and slightly later, as biological dressings added to secondarily opened or unhealed wounds. However most of them, such as AlloDerm, is constructed without an epidermal layer and requires its harvesting as ultra thin grafts. Thus this does not solve the above mentioned problem of iatrogenic injuries at the site of the harvest, and does not shorten the healing period to under 4 weeks (11). Use of Apligraf that contains cells of both dermis and epidermis, there is no need to harvest autologous grafts, which does not solve a problem of long postoperative healing that lasts 4 to 6 weeks. What is interesting, authors who used Apligraf still observed non-healing wounds on the dorsal surface of the hands and in the interdigital spaces (12). This does not seem to indicate that the preparation is superior to the treatment method without grafts, described by us. Maybe proteins that facilitate healing, which are currently under investigation, prove better solution (13), or techniques involving allogenic fibroblast cell therapy that are able to produce collagen VII in the skin, without the need of genetic modification (14).

In conclusion, we presented results of treatment of Epidermolysis bullosa dystrophica (EBD) with an established method involving use of small autogenous full thickness skin grafts. The results indicate that the presented technique results in quick wound healing only in some patients. Very similar methods used by other authors contributed to early healing in all patients. These discrepancies are difficult to explain. Despite the fact that an observed number of early and late recurrences is not different from the rate considered good, long postoperative healing time shortens the period of full efficiency between the recurrences. This method, despite its advantages, seem to need improvement.

CONCLUSIONS

Treatment of syndactyly in Epidermolysis bullosa dystrophica using a graft-free method or using small full thickness grafts, does not result in predictable and fully repeatable results. Postoperative wound healing may take several weeks to complete and its course may be variable. Thus the treatment planning should involve serious risk of unexpected difficulties and failure.

REFERENCES


Received: 13.06.2008 r.
Adress correspondence: 00-416 Warszawa, ul. Czerniakowska 231