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Progressive skin extension: clinical and histological evaluation of a modified procedure using Kirschner wires

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SUMMARY. We describe a modification of a skin traction system for progressive skin extension before excision of skin lesions. The traction device consists of Kirschner wires and plastic straps. It results in more homogeneous traction and greater sparing of healthy skin as compared with the earlier silicone bar method. Moreover, the procedure results in lower rates of infection, skin necrosis and breakage of the cutaneous bridges. Histological changes to the treated skin area are similar to those obtained with skin expansion procedures.

Keywords: progressive skin extension, Kirschner wires.

Progressive skin extension (PSE) is a simple procedure by which wounds are closed by drawing together their edges. This technique, in which forces are applied tangentially to the skin surface, exploits the skin's mechanical and biological characteristics to obtain a linear increase of the surface, unlike tissue expansion in which skin is radially enlarged. PSE has been previously performed with 1-cm-wide plastic straps inserted through the skin and attached to silicone holding bars.[1] However, this technique frequently results in breakage and necrosis of the skin bridges. In an attempt to reduce these events and to obtain more even traction, we performed the procedure with the Kirschner wires in 16 patients.

Materials and methods

From January to December 1995, 16 cases were treated by PSE (two post-traumatic scars, two post-surgical unstable scars, two port-wine stains, four congenital naevi and six tattoos) (Table 1). The procedure entailed four steps: positioning of the traction wires; the extension period; removal of the wires; and finally, lesion excision and wound closure. Patients with limb lesions measuring at least 4 cm and trunk lesions of at least 8 cm were selected for treatment. Contraindications were malignant tumours, recent burns, open trauma and immature scars. Patients with face or neck lesions and lesions of flexor zones such as the elbow, the popliteal region or the inguinal region were excluded.

The system consisted of two 2-mm-diameter wires (Kirschner wires) and several plastic straps with a one-way locking device at one end. After local infiltration of anaesthetic, the wires were inserted into the skin at either side of the lesion to be excised, passed subcutaneously for some distance and then out of the skin to form two or more equal-sized bridges as required (Fig. 1); a rubber tube placed over the ends of the wires minimised patient discomfort. The wire bridges served as support for the straps. The straps, placed parallel to each other, were looped around the wire bridges and fastened. From two to six straps were used in our patients, depending on the size of the lesion.

Finally, all the straps were tightened to create a moderate degree of skin tension. From the second postoperative day, the straps were tightened slightly every other day, so that the surrounding skin was gradually and gently stretched (Fig. 2). In most cases, five adjustments performed over 14 days were sufficient to complete the procedure. When the wires were touching, they were left in place for 1 week, after which the system was removed, the lesion was excised and the wound was sutured (Fig. 3).

In eight of the 16 patients treated, a skin biopsy was taken near the lesion to be excised before and after the extension to evaluate changes induced by the extension.

Figure 1—Haemangioma of the medial aspect of the left thigh. Insertion of the wires into the skin, at the edges of the lesion.

Table 1 Details of patients

Patient	*Age*	*Lesion*	*Site*	*Size*	*Duration of extension*	*Number of adjustments*	*Interval between positioning of device and wound closure*	*In/Outpatient*	*Complications*	*Max. width of scar*	*Follow-up*
V.S.	38	Tattoo	Lateral arm	10 × 6 cm	15 days	5	21 days	Outpatient	None	0.6 cm	28 months
D.D.M.	28	Post-surgical scar	Lower leg	14 × 4 cm	10 days	4	17 days	Outpatient	None	0.5 cm	24 months
A.P.	22	Tattoo	Deltoid	6 × 5 cm	16 days	6	21 days	Outpatient	None	0.6 cm	23 months
A.A.	15	Port-wine stain	Medial thigh	17 × 6 cm	14 days	5	21 days	Outpatient	None	2.4 cm	20 months
L.A.	8	Hairy naevus	Buttock	10 × 7 cm	14 days	5	21 days	Inpatient	None	0.4 cm	18 months
L.C.	24	Post-traumatic scar	Upper back	23 × 9 cm	19 days	7	24 days	Inpatient	Infection	0.7 cm	18 months
G.C.	31	Congenital naevus	Upper arm	8 × 4 cm	14 days	5	21 days	Outpatient	None	0.3 cm	18 months
P.R.	17	Congenital naevus	Lower leg	15 × 6 cm	14 days	5	21 days	Outpatient	None	0.4 cm	16 months
F.B.	27	Tattoo	Upper back	19 × 8 cm	16 days	6	23 days	Outpatient	None	0.8 cm	16 months
C.C.	19	Congenital naevus	Lower back	10 × 13 cm	12 days	5	19 days	Outpatient	Infection	1.5 cm	14 months
S.V.	35	Post-surgical scar	Deltoid	11 × 4 cm	13 days	5	20 days	Outpatient	None	1 cm	12 months
G.G.	29	Tattoo	Scapular	9 × 8 cm	14 days	5	21 days	Outpatient	None	1.8 cm	10 months
P.A.	18	Port-wine stain	Forearm	12 × 7 cm	10 days	4	16 days	Outpatient	None	0.5 cm	9 months
N.S.	21	Tattoo	Upper arm	7 × 5 cm	14 days	5	21 days	Outpatient	None	0.6 cm	7 months
E.S.	28	Post-traumatic scar	Lateral thigh	20 × 7 cm	12 days	5	18 days	Inpatient	None	0.8 cm	7 months
D.P.	23	Tattoo	Deltoid	11 × 7 cm	14 days	5	21 days	Outpatient	None	0.5 cm	4 months

Figure 2—Skin traction system during extension period.

Figure 3—Excision of the lesion and primary suture of the wound: postoperative result.

Figure 4—Follow-up after 20 months showing a stretched scar.

Results

In all of the 16 cases treated by this method, we were able to suture the wound primarily. In two patients, a slight infection appeared where the Kirschner wire entered the skin, but this did not affect the treatment schedule. The wires were well tolerated by all patients and in no case had to be removed before extension was completed. Relevant stretching of the scar was present in three patients. In all cases, the final scar was aesthetically acceptable (Fig. 4).

Compared to initial histology, biopsies of extended skin, sampled from 17 to 23 days after the device was applied, showed:

1. In the epidermis, an increased thickness of the keratinic layer with increased mitotic activity in the basal layer and a slightly increased epidermis in toto (Fig. 5A,B).
2. In the dermis, a thinning and longitudinal re-orientation of collagen fibres in the direction of traction with thinning of the dermis in toto and a clear pattern of lymphocytic vasculitis (Fig. 6A,B).

Discussion

PSE performed with Kirschner wires produced very satisfactory results in our series. PSE can be used in selected cases in which primary closure is not possible by other means and the lesion appears too small to merit skin expansion using balloon tissue expanders.

The use of Kirschner wires[2] instead of silicone bars resulted in a remarkable saving of healthy skin around the lesion. The system allowed a better distribution of tangential forces, and thus the skin bridges remained intact. In a previous study, skin bridge breakage occurred in three out of 15 patients treated by using the silicone bar device, and in one case the device was removed because of extensive skin breakage.[3] The rate of infection in the 16 patients of the present study was very low, comparable to that of the silicone bar procedure. The use of the procedure described in this study is not recommended near joints.

Histological changes after skin extension were essentially the same as those caused by tissue expansion.[4–6] The epidermal thickening and increased mitotic activity are common to both expansion and extension. A decrease in the overall thickness of the dermis occurs most rapidly during the first week of expansion, and an identical response is seen in skin extension. Thin collagen fibres are seen in both processes. We did not find any myofibroblasts in our biopsies; they are usually observed in the specimen only after several weeks of expansion. Another typical feature of expanded skin biopsies, namely the fibrous capsule that normally develops around all tissue expanders, was obviously not found, as our technique does not use internal implants.

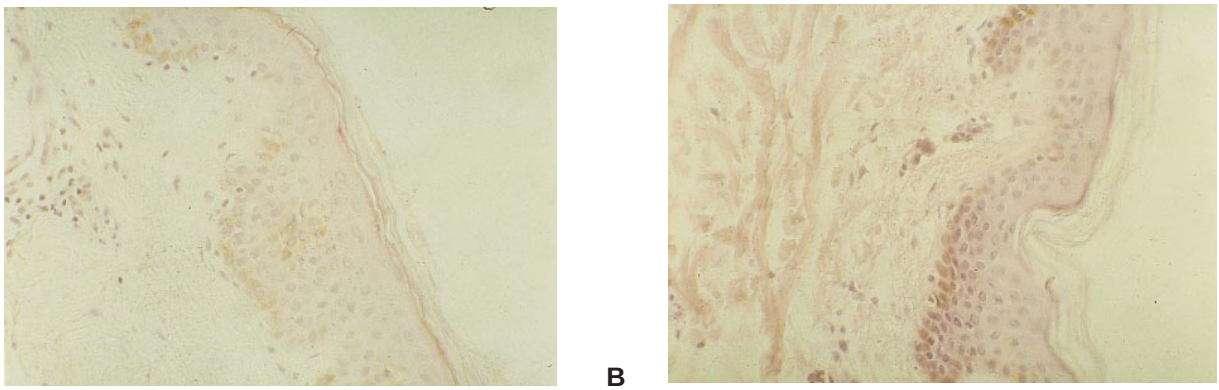

Figure 5—Histological evaluation of epidermis: (A) before skin extension; and (B) after skin extension: thicker keratinic layer, increased mitotic activity in the basal layer and slightly thickened epidermis in toto.

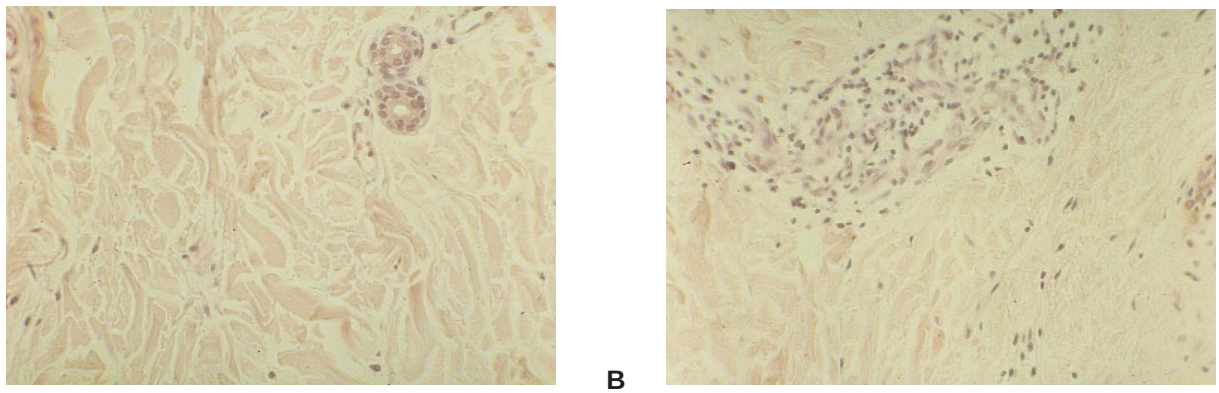

Figure 6—Histological evaluation of dermis: (A) before skin extension; and (B) after skin extension: thinning and longitudinal re-orientation of collagen fibres, a clear pattern of lymphocytic vasculitis and a thinning of the dermis in toto.

Skin expansion and extension are similar techniques based on similar biological mechanisms. In both expansion and extension, the more elastic components of the skin tend to partially return to the preprocess state following discontinuation of the process. With tissue expanders it is possible to hyperexpand the skin to provide additional surface area in an attempt to prevent scar stretching, a common feature in skin-expansion surgery. With our external extension device, hyperextending the skin is not possible. That could explain the scar stretching observed in some of our patients.

However, because of their complexity, skin expanders are costly and time consuming, whereas PSE performed with Kirschner wires is inexpensive, and can give comparable results. In conclusion, we recommend that Kirschner wires be used in PSE procedures.

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