Application of silicon tissue expanders for the direct or indirect coverage of soft tissue defects in the extremities

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In a 2 year prospective study, 17 tissue expanders were placed on the extremities of 17 patients. The aim was to cover soft tissue defects in the forearm of 8 patients after chinese flap dissection, which was used either as a free or reversed flap. In 8 of the remaining patients, the expanded skin was placed directly on the affected region as a local fasciocutaneous flap. In 1 patient it was determined intra-operatively that the prepared extended skin was not necessary to treat the patient. The tissue expander was successfully used to cover skin defects, both directly and indirectly, in the lower extremity (7 cases) and in the upper extremity (9 cases). Neither infection nor necrosis was observed in the flaps and the cosmetic results, particularly in the forearm, were satisfactory.

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The application of tissue expanders in an extremity has been found safe only in the upper tibia, the knee region and the upper extremity (Spodnick et al. 1993). In the distal half of the tibia, the foot and the palm, there is a limited capacity of the skin for distension. Thus, the use of a tissue expander in these areas for direct coverage of missing tissue is difficult, and free flaps, such as the chinese flap, are indicated. However, in these cases the tissue expander may also assist indirectly by supplying additional skin for coverage of the defect remaining on the forearm after the chinese flap dissection.

Patients and methods

In a 2-year study at the Department of Orthopaedic Surgery, University of Ioannina Medical School, tissue expanders were applied 17 times in 17 patients. 15 men and 2 women, with ages ranging from 14 to 65 years participated in this prospective study. Patients were examined bimonthly throughout the 2 year study period to assess the results following the initial application of the tissue expander.

Indications, limitations, complications, as well as the cosmetic results of the covered defect were evaluated. Particular emphasis was placed on donor site cosmesis in patients who were treated with the tissue expander compared to patients in whom the current method of covering the defect with a split thickness skin graft was used.

The most common size of tissue expander was 12–16 cm. The placement was done through 2 incisions 3 cm in length which corresponded to the 2 edges of the rectangular tissue expander. To insert the tissue expander, the deep fascies of the skin were first identified and separated from the underlying tissues. The silicon tissue expander was then introduced along with approximately 40 mL of Ringers solution. Each week an additional 30–40 mL of Ringers solution was injected into the expander until it was full. Care was taken to monitor the condition of the distended skin.

Results

The majority of patients were young with severe soft tissue defects as a result of major trauma. With the exception of 1 patient, the average age of this group of patients was 26 (14–45) years. The one older patient, a 65-year-old woman, had extensive dermal necrosis caused by aterial thrombosis following total knee replacement.

In 8 patients the tissue expander was placed on the extensor surface of the forearm for the preparation of a chinese flap. The chinese flap was used as a free flap in 4 patients (on the heel in 2 patients, on dorsum

Table 1. Details of 16 patients in whom a tissue expander was used

Age	Sex	Defect	Application site	Type of flap	Observations
27	M	Corrugated scar on palm	L forearm	Free chinese	
34	M	Soft tissue defect on L heel	R forearm	Free chinese	2 cm scar dehiscence
35	M	Soft tissue defect on R heel	L forearm	Free chinese	2 cm scar dehiscence
44	M	Corrugated scar on R palm	R forearm	Reversed chinese	
22	M	Unstable scar on R elbow	L forearm	Reversed chinese	
34	M	Crush injury to L foot	R forearm	Free chinese	
30	M	Corrugated scar on R palm	R forearm	Reversed chinese	
25	M	Finger transposition to thumb after crush injury	L forearm	Reversed chinese	
15	M	Corrugated scar on extensor tendons of distal forearm	L forearm	Local fasciocutaneous	
22	M	Corrugated scar on extensor tendons of distal forearm	R forearm	Local fasciocutaneous	
14	M	Finger transposition to thumb after crush injury	L hand	Local fasciocutaneous	
25	M	Corrugated burn scar on elbow and forearm	R forearm	Local fasciocutaneous	
65	F	Skin necrosis after total knee replacement	Medial side of knee	Local fasciocutaneous	with medial gastrocnemious
40	M	Unstable scar on proximal tibia	Medial side prox. tibia	Local fasciocutaneous	
45	M	Mid-tibial skin defect	Medial tibia	Local fasciocutaneous	
21	F	Corrugated transverse of mid calf	Mid calf	Local fasciocutaneous	

of the foot and on the contralateral palm in 1 patient each). In another 4 patients, the chinese flap was used as an island flap (three times on the palm and once on the elbow).

In 2 patients with large defects in the knee area (about 10–12 cm), a medial gastrocnemious flap was used in addition to the fasciocutaneous flap gained by skin extension. In one patient who had been prepared for correction of corrugated scaring as a result of burns on the palm and fingers the tissue expander was removed since adequate extension of the fingers could be achieved with Z-plasty incisions. Two weeks later the skin returned to its original condition.

None of the patients demonstrated signs of infection. In one case a large sinus developed at the injection site and the tissue expander was changed. Necrosis of about 1cm in diameter occurred above one corner of the tissue expander in another patient, and the necrotic tissue was excised. There were no further incidences of dermal necrosis in this or any other patient.

In all patients who underwent chinese flap preparation, cosmetic convergence of the tissue deficit occurred. In 2 patients, 1-2cm dehiscence of the scar was observed 2 and 4 months post-operatively. Even with the dehiscence the cosmetic result was better than that achieved by split thickness skin grafts (Figure 1).

Discussion

The results from the present study indicated that the application of a tissue expander may be beneficial for reconstructive microsurgical procedures in the extremities. Tissue expansion may be used to cover soft tissue defects either directly in the surrounding area or to cover the defect remaining after chinese flap preparation on the forearm. The latter allows for indirect use of the tissue expander for those areas where the skin is not normally expandable or where there is greater potential for necrosis, such as in the palm, the distal half of the tibia and the dorsum of the foot. The absence of dermal necrosis in our patients may be explained by the fact that we avoided direct use of a tissue expander in these areas (Spodnick et al. 1993).

The absence of inflammation was possibly related to the fact that the flaps were not used to cover osteomyelitic areas, but were confined to treat only areas with unstable scaring. Muscle flaps were preferred in patients with untreated inflammation, as in the presence of inflammation, muscle flaps add a greater blood supply to the area.

Studies have shown that the skin may be stretched up to 35 percent without causing problems (Meland et al. 1992). This restricts the use of the tissue expander to cases where the defect of skin does not exceed this amount. In practice this means defects no greater than 5 cm in width. However, the tissue expander may be successfully used in conjunction

Figure 1. Tangential skin defect following trauma on the left heel of a 34-year-old laborer (top left) which was treated with a forearm free flap (bottom left). A tissue expander was placed in the forearm (top right). The resulting cosmetic appearance of the donor site was acceptable in spite of the 1 cm scar dehiscence, both with palm open (middle right) and with the fingers flexed (bottom right).

with other microsurgical procedures as illustrated in the 2 patients with large defects in the knee region. In these patients a medial gastrocnemious flap was used along with the tissue expander because of prohibitive size of tissue defect.

Even when dehiscence of the scar appeared postoperatively, the cosmetic results of the forearm after dissection of the chinese flap were incomparably better when a tissue expander had been applied compared to coverage of the defect with a spit thickness skin graft.

References

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