



A peri-implant capsule flap

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SUMMARY. Spherical expanders (30 ml) were implanted under the skin vascularised by the left inferior epigastric pedicle in rats.

When expansion was complete, the expander was removed and the animals divided into three groups of 15. In the first group, the floor of the capsule was simply everted. In the second group, a capsule island flap was raised; in the third group, a capsule free flap was raised, transferred to the heterolateral vessels by microanastomosis; the inner side of the various capsule flaps was covered with autologous skin graft. In the three experimental groups, there was complete "take" of the skin grafts in 80% of the animals.

Pedicle or free flaps of capsular tissue may be raised and transferred safely in rats.

An inflatable prosthesis was used for the first time in 1957.¹

A silicone implant induces the formation of a capsule by the host. This phenomenon is well documented since capsular contracture is common around mammary prostheses.²

Three to four weeks after insertion of the implant, the capsule is already formed and made of capillaries, larger blood vessels, active macrophages, fibroblasts, myofibroblasts and a small amount of collagen. Later the capsule becomes less vascularised, more and more collagen is laid down and macrophages become inactive.³

The aim of our study was to examine whether this side effect could be used as a new source of flaps since the capsule has a structure and texture similar to fascia. With this objective, capsule formation was induced in rats by inserting a tissue expander under the skin vascularised by the inferior epigastric vessels.

When the capsule was formed, it was raised either as an island flap or a free flap; it was then covered by a full thickness skin graft to find out whether a peri-implant capsule was an adequate recipient site. If so, this might be a new source of flaps for use in reconstructive surgery.

Materials and methods

30 ml sterile spherical skin expanders (6 × 3 cm) (C.U.I. USA) with a remote port were implanted under the skin vascularised by the left inferior epigastric pedicle in 45 male Wistar rats (350 g) anaesthetised with Hypnorm® (0–1 ml/100 g IM) (Janssen Pharmaceutica—Beerse Belgium).

All surgical procedures were done under sterile conditions.

The skin expander was placed underneath the left lateral abdominal skin and epigastric vessels (Fig. 1) through a longitudinal skin incision.

The position of the implant was secured by suturing the subcutaneous tissue to the muscle with a 3/0 resorbable suture. The wound was closed with 4/0 nylon.

The expanders were filled on days 7, 14 and 21 post-operatively with 10 ml of saline solution.

One month after implantation, *i.e.* 9 days after the last expansion, the second stage was performed.

In the first group of 15 rats, the expander was removed and the floor of the capsule was sutured to the surrounding skin (Fig. 2A) and covered with a full thickness skin autograft (Fig. 2B).

This control group was established to check whether the original capsule was an appropriate bed for a skin graft.

In the second group of 15 rats, an island flap harvested from the anterior and inferior aspect of the capsule (3 × 2 cm) was raised on the left epigastric vessels, turned inside out and immediately covered by a full thickness skin graft (Fig. 3). In 5 rats, a silicone sheet was placed under the capsule-cutaneous flap to prevent revascularisation from the underlying muscle.



Fig. 1

Figure 1—Left inferior epigastric vessels with vascular network under which expander was placed.



Fig. 2

Figure 2 (A) Eversion of the peri-implant capsule. (B) Everted capsule covered with autologous skin graft.

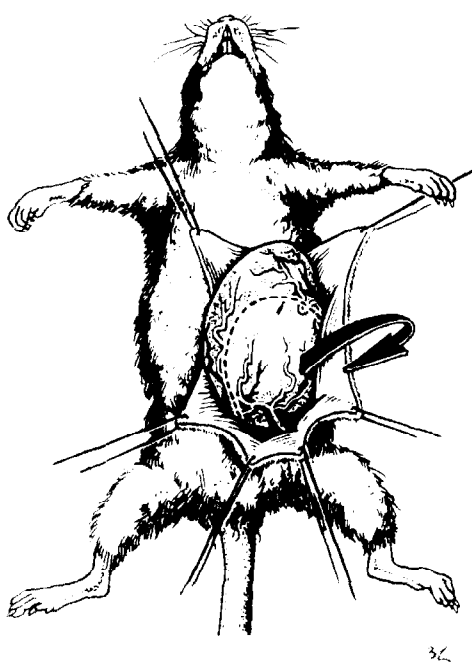


Fig. 3

Figure 3—Island flap from the anterior and inferior aspect of the capsule, turned inside out and covered with autologous skin graft.

In a third group of 15 rats, a peri-implant capsule free flap (3×2 cm) was raised on the left femoral vessels (Fig. 4A) and transferred to the heterolateral femoral vessels by termino-terminal microanastomosis (10/0 nylon) (Fig. 4B), the posterior vessels maintaining sufficient circulation to the leg.

The free flap was also turned inside out and immediately covered by a full thickness skin graft.

The skin grafts were secured by a tie-over dressing.

One week later, the dressing was removed and the operative site carefully inspected.

Biopsies of the capsule-skin unit were taken in each experimental group one month after skin grafting and fixed in 4% buffered Formalin-Paraffin. Sections were stained with haematoxylin and eosin.

The vascular network of the capsule was assessed by arteriography in two animals in each experimental group.

Results

Arteriography (Fig. 5) shows that the vascular network is mainly located in the inferior and anterior part of the capsule.

Figure 6 shows the usual appearance of a pedicled capsule flap 1 week after skin grafting with or without insertion of a silicone sheet.

The homogeneity of the capsule-skin unit is confirmed by optic microscopy (Fig. 7).

The results presented in the Table clearly show that the peri-implant capsule is an adequate bed for a skin graft whatever the experimental conditions.

Discussion

Analysis of the soft tissue response to the insertion of an implant reveals a normal wound healing process which is modified by the presence of a foreign body.¹ This increases the fibrous component which resolves once the silicone is removed.⁵

The study of development of the capsule is interesting if it is planned to be used as a flap. In the early

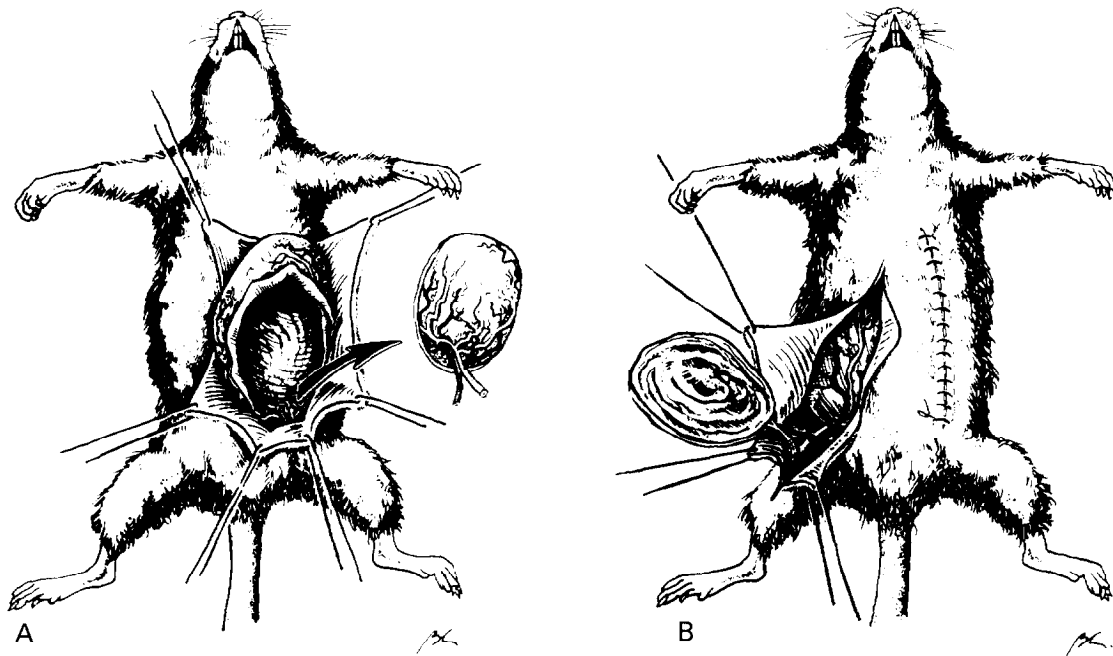


Fig. 4

Figure 4—(A, B) Capsule free flap turned inside out, transferred to the heterolateral femoral vessels and covered with autologous skin graft.

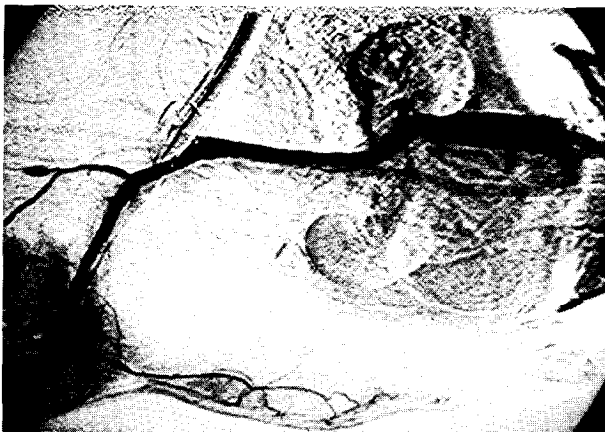


Fig. 5

Figure 5—Arteriography 4 weeks after implantation of the expander. The vascular network is mainly located in the anterior and inferior part of the capsule.

stages, the great cellularity and the rich vascular network provide good conditions for the "take" of a skin graft. In the later stages, the mature collagen layers give some stability. Very thick bundles of collagen fibres are oriented parallel to the surface of the implant.⁶

We decided to use the capsule as a flap after the development of granulation tissue but before the phase of reduced vascularity and scarring. Expanders were chosen rather than silicone implants for two reasons: expansion enhances the growth of the vascular pedicle⁷ and a larger flap may be obtained.⁸

The results in rats clearly show that a capsule may be used either as a pedicle or as a free flap. If this reconstructive idea is applicable to humans, a new source of reconstructive tissue will become available.



Fig. 6

Figure 6—The appearance of capsule-skin unit 1 week after grafting.



Fig. 7

Figure 7—Optic microscopy of the capsule skin unit (haematoxylin and eosin 4×10). 1: skin graft; 2: capsule.

Table Evolution of the healing of the skin grafts in the three experimental groups

	No. of animals	Total necrosis	Partial necrosis (%)	Complete "take" of skin graft
Group 1 eversion	15	0	2 (20)	13
Group 2 pedicle flap	15	1	2 (25)	12
Group 3 free flap	15	1	2 (25)	12

Although this is a 2-stage procedure, there is minimal damage to the donor site.

The late changes in the pseudosheath pocket around a silicone implant must be kept in mind if it is planned to use it as a fascia-like tissue to cover tendons to provide a gliding surface or replace synovium in joints. Indeed, resolution of the capsule after removal of the implant is possible⁵ and the benefit of such transfer might be only transitory with the final risk of causing

a dense scar. A study of the late changes in these flaps is now being undertaken.

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