

AN EXPERIMENTAL STUDY OF DELAY PHENOMENON —ATTEMPTS AT INCREASING THE SURVIVAL LENGTH OF SKIN FLAPS BY USE OF TEFLON SHEET—

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ABSTRACT

An experiment was performed on the delay effect and flap survival in the rat. When the flap was delayed with a teflon sheet, there was greater improvement of vascularity and flap survival than in the group that was delayed without the use of a teflon sheet.

INTRODUCTION

Oral surgeons have been troubled by flap necrosis occurring after the transplantation of the pedicle flap which plays an important role in head and neck reconstructive surgery. The term "delaying a flap" is frequently used in the field of reconstructive surgery to indicate that the flap is being developed and transferred in more than one single stage to ensure its safety.

Hypotheses with regard to the delay phenomenon so far reported can be summarized as follows:

- 1) Delay enables tissues to be conditioned for ischemia, which makes it possible to survive on less blood flow as compared to normal need^{1,2)}.
- 2) Delay improves vascularity^{3,4)} in the transplanted flap. In either case, the purpose of the delay is to keep the flap alive by adapting it for a state of relative hypoxia which takes place when it is raised and transplanted. Williams⁵⁾ (1973), who introduced a surgical technique specific for performance of delay, *i.e.*, insertion of a sheet of silastic beneath the flap, reported that this simple technique can fortify the delay efficacy, and that arising complications can thereby be prevented. The author *et al.* examined the effect of a teflon sheet inserted under the flap upon elongation and also its role in improving the vascularity of the flap.

MATERIALS AND METHODS

Sixty wistar strain male rats aged 8 weeks and weighing 260–300 gm were employed, to the dorsal part of which a single pedicle flap sized 1.5×6 cm and based on caudal side was

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designed under anesthesia of pentobarbital sodium (50 mg/kg) by intraperitoneal injection (Fig. 1).

Those animals were divided into the 3 following groups: control group; the entire flap was raised and immediately sutured back in place (group A), group B, normal delay was performed in distal half of the flap (1.5 × 3 cm), group C; a flap under which a teflon sheet was inserted was resutured with its bed. In groups B and C, the entire flap was raised and sutured back again with their beds 2 weeks after the first operation. The survival length of the flap was measured one week thereafter, and a microangiographic study was also carried out at periods of one and two weeks after the first operation (Fig. 2). Clear visualization of newly formed vascular channels in the flap thereby obtained was to a great extent, and aid in facilitating the subject study⁶.

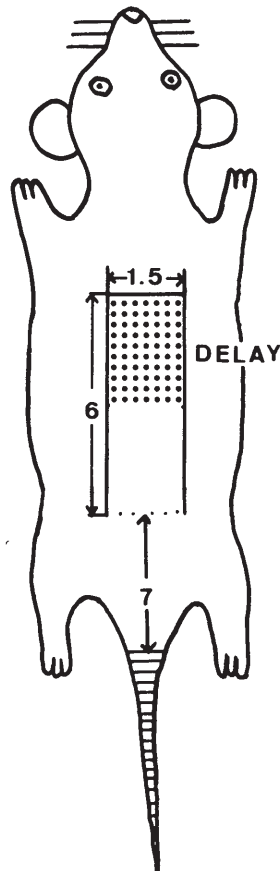


Fig. 1 Single pedicle flap (1.5 × 6 cm) with the base of caudal side was designed in the midline of the dorsum of the rat. Delay was performed in distal half of the flap (1.5 × 3 cm).

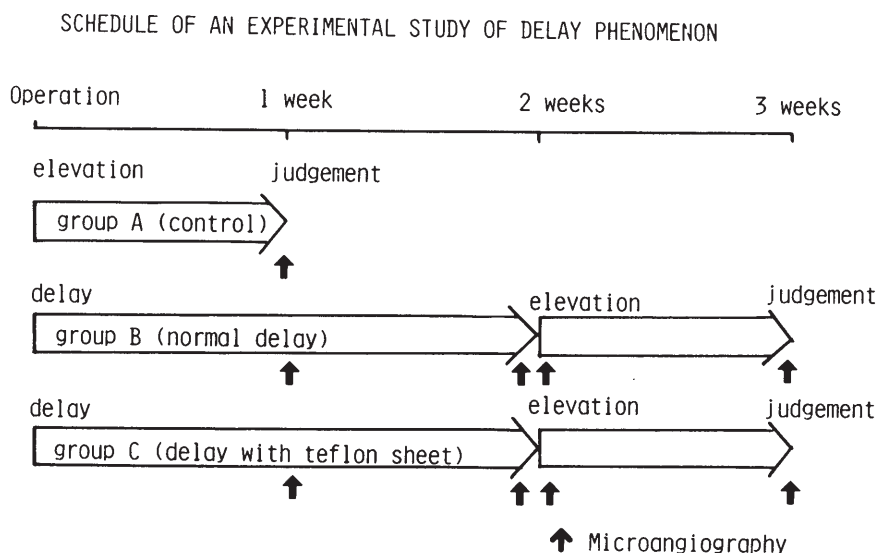


Fig. 2 Schedule of subject experiment; flaps were raised at the 2nd week of the delay initiation in groups B and C.

RESULTS

Survival length of flaps determined

Fig. 3 shows a mean survival length in flaps of each group, in which a definite trend can be seen in groups B and C as compared to the control group; 3.3 ± 0.5 cm in group A, 3.6 ± 0.6 cm in group B, and 4.3 ± 0.8 cm in group C. Statistical analysis taken by t-test revealed no significant difference between B and A. However, group C showed a significant delayed efficacy of the flap survival ($p < 0.01$).

Microangiographic findings

A trace dilatation of venules and a slight increase of capillaries in the flap margin of group B were observed one week after the first operation (Fig. 4), while those findings were marked in group C, indicating overt dilatation of venules and an enhanced vascularization (Fig. 5).

Vascularity returned to a normal pattern in group B, with revascularization between flap and bed being almost completely established two weeks after the first operation (Fig. 6). On the other hand, vessels which remained dilated were directed toward the long axis of the flap in group C, at the same period, supposing axial vessels. Capillaries were formed in the whole area of the flap which was delayed by insertion of a teflon sheet (Fig. 7).

DISCUSSION

There have been elaborated angiographic studies already made on the delay efficacy of the flap.

Velander ⁷⁾ (1964) reported that a longitudinal rearrangement of the major vasculature could be seen in the delayed flap, with no newly formed vessels detected.

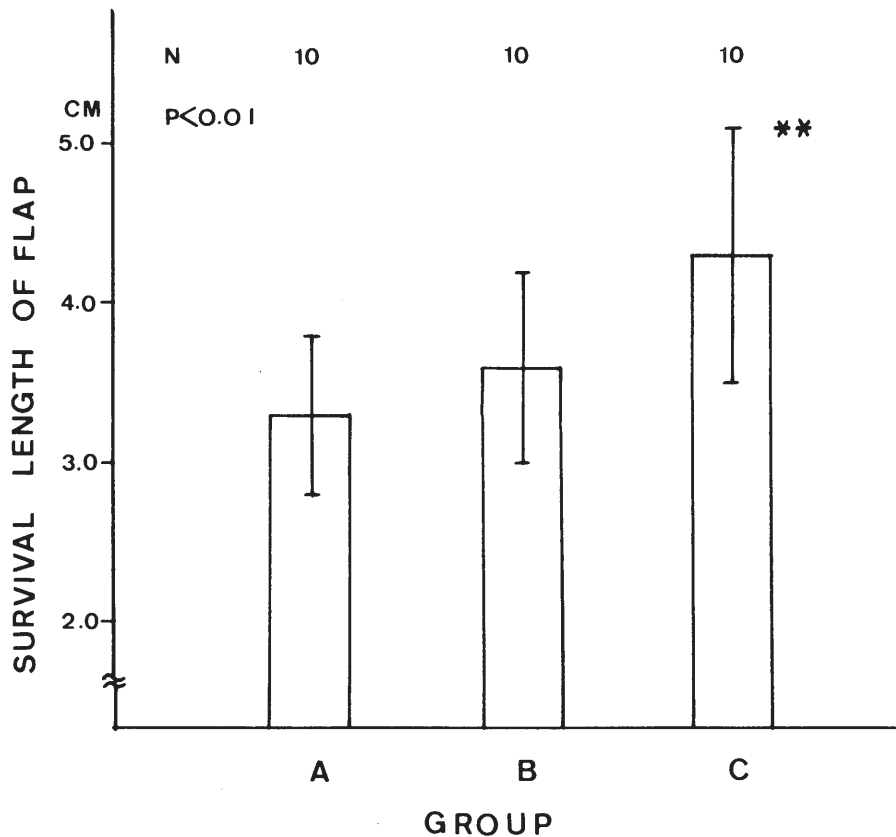


Fig.3 Delay with teflon sheet (group C) increases the survival length as compared to conventional technique (group B). The bars indicate standard deviations.
 **: $p < 0.01$

McFarlane²⁾ (1965) claimed that there was no increase in blood flow induced by an increased number of and an enlarged caliber of the blood vessels in delayed flaps.

Our angiographic study within a week of delay initiation revealed an increase in number of capillaries and vasodilatation in groups B and C. The vasculature, however, returned to normal in group B, and a remarkable increase of blood vessels was observed to remain in group C together with a rearrangement of the main vascular channels which was directed toward the longitudinal axis of the flap at the 2nd week of delay initiation.

These findings of microangiogram corresponded well with the survival length of the flaps finally determined. Group B showed no marked improvement in survival length, while C tended to demonstrate a significant delay of the flap. The results obtained elucidated that the delay efficacy attenuated in the wake of the formation of revascularization was characterized by being transient. It is therefore suggested that revascularization between flap and bed should be blocked, aiming at maintaining the delay efficacy as much as possible through insertion of some sort of biological material such as a teflon sheet under the flap.



Fig. 4



Fig. 5

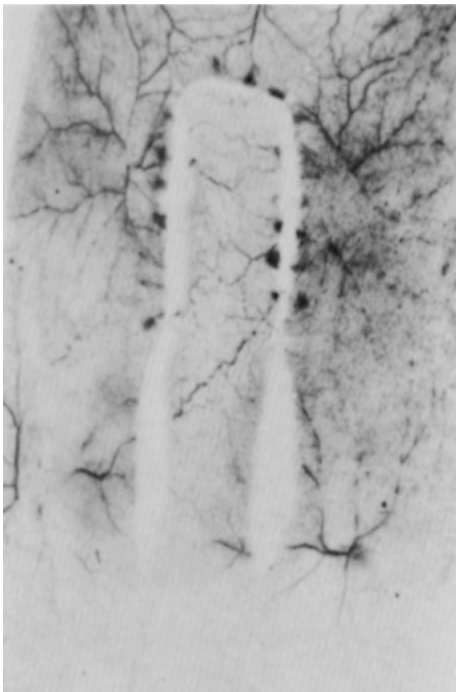


Fig. 6

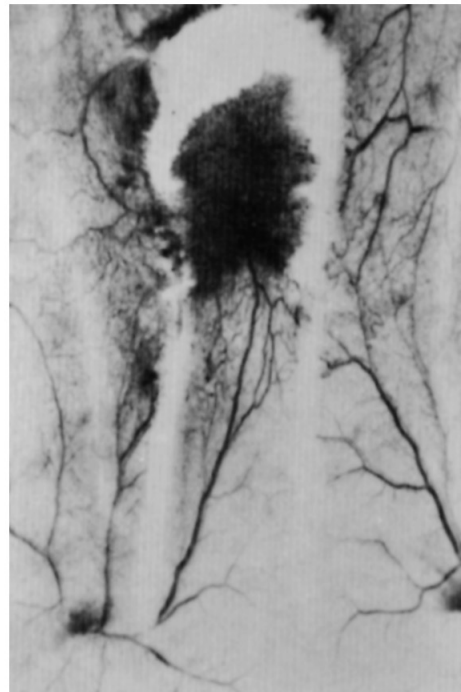


Fig. 7

- Fig. 4 The 1st week following initiation of delay (group B); a slight increase of vessels in flap margin can be seen.
- Fig. 5 The 1st week following initiation of delay (group C); a marked increase of vasculature and dilatation of venules can be observed.
- Fig. 6 The 2nd week after delaying (group B); vascular pattern is returning to normal.
- Fig. 7 The 2nd week after delaying (group C); vessels kept dilated direct toward long axis of the flap, supposing axial vessels.

CONCLUSION

The relationship between the delay procedure and flap survival was investigated in the rat.

- 1) The mean survival length of the control group (non-delayed) was 3.3 ± 0.5 cm. When the flap was delayed without the teflon sheet (group B), it was 3.6 ± 0.6 cm. Yet, delayed with the teflon sheet (group C), it was 4.3 ± 0.8 cm. There was a significant improvement of flap survival in the group which was delayed with the teflon sheet.
- 2) From our microangiographic finding, there was high improvement of vascularity in group C. But in group B, the improvement of vascularity was a transient one and returned to a normal vascular pattern in a week.

SUMMARY

The insertion of the teflon sheet under the flap was studied as to the effects it could exert upon flap survival.

The results obtained indicated that the examination which proceeded using the teflon sheet, when compared to conventional delay, demonstrated an improved vascularity of and also a significant delayed efficacy of the flap.

This in turn suggested the enhancement of delay efficacy shown by this simple technique.

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