

# Staples for wound closure: a controlled trial

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## Summary

*Skin staples were compared with two conventional suture methods for speed, convenience, effectiveness and cost. One hundred and ninety five patients having linear abdominal incisions were randomly allocated to one of three methods of interrupted skin closure—polypropylene sutures, polyglactin sutures or stainless steel staples and the wounds were assessed over 30 days. The mean rate of wound closure using sutures was 4.2 cm per minute while staples were faster at 22.5 cm per minute and saved an average of three minutes per wound. The time saved was considerably greater with long incisions. Staples cost 50p more per 15 cm wound than either suture. In other respects the three methods were comparable except that polyglactin caused the least wound pain.*

*We believe the advantages of speed and convenience of skin staples outweigh the extra cost, provided the disposable instruments are reused until empty.*

## Introduction

Skin staplers are currently enjoying a vogue in the United States of America which is not reflected to the same extent in the United Kingdom. Satisfactory disposable cartridges and instruments have only recently become available and while reports suggest they are a rapid and cosmetically acceptable alternative to conventional methods, their widespread introduction has undoubtedly been limited by the expense of using a disposable item costing upwards of £6 to close one wound. This trial set out to compare two conventional suture methods of skin closure with a disposable skin stapler (TW35 Proximate Mk II, Ethicon Ltd, Edinburgh), which although intended for single use, was sterilised and reused until empty. The three methods were compared for speed, cost and cosmetic result, while checking the usual criteria of satisfactory wound closure. Particular attention was paid to determine whether reuse of the instrument predisposed to increased wound sepsis.

## Materials and methods

Over a twelve month period all patients under the care of CRGQ and MSO-S (7 months) and GJ (5 months) undergoing elective or emergency abdominal operations with incisions longer than 10 cm were included in the study. Children under 15 years were excluded but no upper age limit was imposed. One hundred and ninety five patients took

part and they were allocated by means of balanced randomisation to one of three categories:

- 1 2/0 polypropylene (Prolene, Ethicon) interrupted vertical mattress sutures.
- 2 3/0 coated polyglactin (Vicryl, Ethicon) interrupted vertical mattress sutures.
- 3 Stainless steel staples (Disposable Proximate TW35, Ethicon) sterilised in activated glutaraldehyde and reused until empty.

In use, the TW35 stapler bends the side legs of each staple inwards to grip the skin firmly, leaving space between the crossbar and the skin. After use, the TW35 staplers were sterilised in activated glutaraldehyde for three hours.

Operations were categorised as to whether routine or emergency; contaminated or clean. The methods of skin closure for each case was determined after repair of the deeper layers, by the next sequence number from a randomisation chart, balanced every twelve cases. The process of closure was timed in seconds, the length of the wound was measured and the number of staples or number of suture packs used was recorded. Staples or sutures were placed approximately 1.3 cm apart.

The effectiveness of closure was graded at operation and again on the second, tenth and thirtieth post-operative days. A wound was considered to be infected if discharge or distinct redness were present. Antibiotic prophylaxis was identical for all groups with intravenous cephalosporin and metronidazole suppositories given preoperatively, and six and twelve hours postoperatively. In contaminated operations the antibiotic cover was continued for between five and ten days.

Staples were removed with a device that painlessly opened them sideways, while polypropylene sutures were removed in the conventional way. Polyglactin sutures were cut flush with the skin. Wound closures were generally removed at ten days and the ease or difficulty of removal was recorded. Pain attributable to the skin closure was assessed as either present or absent at each stage. The cosmetic appearance was assessed 'blind' at thirty days.

## Results

One patient was lost to follow-up and seven died of unrelated causes within thirty days of operation. The latter were included only in the early assessment. Stapler malfunction wasted time on seven occasions while the jammed staple was removed. Rate of wound closure was calculated in cm per

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minute and materials were compared statistically in pairs by Student's *t*-test (Table I). Wounds were closed five times faster with staples than with either suture ( $P < 0.001$ ). No significant difference was found between the two suture materials ( $0.5 > P > 0.1$ ). The relative cost of closing 15 cm of wound (the average of all groups) is shown in Table 1.

There was more wound infection in the staple and polypropylene groups. None of the materials provoked an obvious inflammatory response. The polyglactin group had a low incidence of wound pain. Cosmetic appearance of the wounds at thirty days, effectiveness of closure and patients' opinion were not significantly different between any of the groups (Table II).

TABLE I Relative rates of skin closure and cost between the three materials

Materials	Rate of closure (cm per minute)	Cost for 15 cm of wound
Polypropylene <i>n</i> = 65	3.7	£1.24
Polyglactin <i>n</i> = 65	4.7	£1.39
Staples <i>n</i> = 64	22.5	£1.82

## Discussion

Modern mechanical suture devices were pioneered in the USSR and later introduced into the USA (1). The development of mechanically satisfactory skin staplers appears to represent an important advance in rapid and effective means of closing long skin incisions. There is evidence that the method causes considerably less damage to wound defences when compared even with the least reactive nonabsorbable suture materials (2).

Proximate II is a mechanical improvement on version I, but nevertheless seven failures were recorded. Mechanical failure occurred twice when a new instrument was being used, the other five occasions were with re-sterilised instruments. Whilst the instrument is not designed to be re-sterilised the manufacturers (Ethicon Ltd) supplied the instruments for the study in full knowledge of the protocol. Because of re-sterilisation higher failure rates might reasonably have been expected with extended use. However this occurred with diminishing frequency as operators became familiar with the technique and it is likely that operator misuse was a more important cause of failure than mechanical defects. Compared with other staplers, visibility of the skin being approximated with this instrument is limited because it is applied perpendicular to the skin and there is no pre-cocking mechanism to allow a trial of staple position.

TABLE II. Assessment of wound closure with the three materials (numbers of cases)

Material	Wound pain	Painful removal	Difficult removal	Infection	Grading of closure at 30 days		Grading of cosmetic appearance at 30 days	
					A	B	A	B
Polypropylene <i>n</i> = 63	9	6	2	4	57	6	51	12
Polyglactin <i>n</i> = 63	1	7	3	1	60	3	55	8
Staples <i>n</i> = 61	8	9	2	5	58	3	51	10

A Excellent  
B Moderate

TABLE III Operations in each group

		Polypropylene <i>n</i> = 65	Polyglactin <i>n</i> = 65	Staples <i>n</i> = 64
Colonic	R	4	5	5
	E (cont)	12 (7)	7 (3)	14 (7)
	Total	16	12	19
Biliary	R	7	7	4
	E (cont)	3 (2)	1 (-)	2 (1)
	Total	10	8	6
Gastric and (small bowel)	R	3	3	4
	E (cont)	5 (2)	1 (1)	6 (2)
	Total	8	4	10
Herniorrhaphy	R	21	28	17
	E (cont)	4 (2)	1 (-)	4 (1)
	Total	25	29	22
Others	R	6	12	7
	E (cont)			
	Total			
Total	Routine	41	55	37
	Emergency	24	10	27
	(contaminated)	(13)	(4)	(11)

R Routine  
E Emergency  
cont contaminated

The price of a packet of polyglactin was 79p and a packet of polypropylene 69p while a disposable stapler cost £6.00 but was used on an average of 4.2 cases. The average wound of 15 cm was closed 196s quicker with staples than with polypropylene at an extra cost of 59p and 150s quicker than with polyglactin at an extra cost of 43p. The average saving of just over three minutes in closing a 15 cm wound with staples could be extrapolated to a gain of 15–20 minutes on an average operating list for an extra cost of less than £5. Apart from the more efficient use of theatre time, the psychological effect of rapid wound closure at the end of a long operation on surgeon and theatre staff was very evident during this trial. Continuous sutures save some time but have been shown to take two minutes longer than staples over 15 cm (4), whilst making partial opening of an infected wound difficult.

The higher rate of wound infection in the polypropylene and staples groups was directly attributable to the greater proportion of contamination in emergency gastrointestinal operations in these groups (Table III). In those cases where organisms were cultured from wound discharge the type was directly related to the particular operation. All infections developed after emergency gastrointestinal surgery and the organisms were invariably gastrointestinal flora—*E. coli*, *Strep faecalis*, *bacteroides*, *clostridia*. This was the same for all groups. Local suture removal was necessary in moderately infected wounds to allow drainage but staples allowed satisfactory drainage without removal. No increased predisposition to infection was apparent with reuse of the stapling device.

Wound pain attributable to the sutures was remarkably low in the polyglactin group. No explanation for this could be found and it would merit further study. Excessive pain has been reported in stapled wounds (3) but in this series there was no difference between staples and interrupted polypropylene, though polyglactin was superior to both.

The cosmetic results from all three groups at one month were so similar, it was not considered essential to extend the

follow-up of patients most of whom would normally have been discharged at that visit.

### Conclusions

Staples did not cause excessive wound pain though polyglactin appeared to be superior to both other methods. Local staple removal was unnecessary to allow drainage of moderately infected wounds and routine staple removal was no more difficult nor painful than suture removal. No difference was found in the final grading of wounds between the groups, so the merits of stapling come down to its convenience, rapidity and cost. Staplers were well liked by operators and resulted in a substantial and worthwhile saving in time for wound closure. Provided the instruments are reused, stapled skin closure is not as uneconomic as previously believed.

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### References

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## Notes on books

**Lipoplasty: The Theory and Practice of Blunt Suction Lipectomy** edited by Gregory P Hetter. 340 pages, illustrated. Little, Brown, Boston. \$95.00.

This handsomely produced and copiously illustrated monograph is directed towards plastic surgeons who specialise in aesthetic surgery. It covers in great detail the new technique of suction lipectomy which enables the human form to be shaped into a different contour. Twenty-four plastic surgeons contribute and cover not only the detailed techniques but also such subjects as harmony and proportion in the female form and the psychological aspects of treatment.

**Aesthetic Plastic Surgery: Principles and Techniques** edited by Paule Regnault and Rollin K Daniel. 737 pages, illustrated. Little, Brown, Boston. \$125.00.

Beginning with a fascinating chapter on the history of aesthetic surgery this book goes on to cover all its many aspects. It is extensively illustrated and referenced. Major sections are devoted to rhinoplasty, facial procedures, face lift, breast surgery and body contouring. Twenty-six plastic surgeons from the United States and Europe contribute. All plastic surgeons will find the volume of interest.

**Guillaume Dupuytren—A Surgeon in his Place and Time** by Hannah K Barsky. 295 pages, illustrated. Vantage Press, New York. \$14.95.

Every medical student knows about Dupuytren's contracture. This biography tells the story of this great French surgeon against the background of his time and the people he knew. Unlike most surgeons of today, Dupuytren was acquainted with the leading literary and political figures of his time together with Kings and Queens. The book is not merely the study of a surgeon; it is also an account of a country undergoing revolutionary changes and the progress of a man through those changes. It deserves wide sale.

**Cataract Surgery** edited by Arthur D McG Steele and Robert C Dews. 383 pages, illustrated. Butterworths, London. £55.

This is Volume 2 in the Ophthalmology Series of Butterworths International Medical Reviews. Over 30 contributors from North America and Western Europe present an up-to-the-minute picture of the management of cataract. There have been many changes in this subject over the past ten years and this book is directed to both the practising surgeon and the trainee. It is extensively illustrated and adequately referenced.