ORIGINAL ARTICLE

Prospective randomised trial comparing traditional suture technique with the dynamic sliding loop suture technique in the closure of skin lacerations

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Objective: The aim of this study was to compare the cosmetic appearance and related complications of selected skin lacerations closed by traditional suture technique with that of the dynamic sliding loop suture technique.

Design: Prospective, randomised clinical trial.

Setting: A district general hospital.

Participants: Thirty seven eligible patients aged between 16 and 60 years with skin lacerations (no deeper than superficial fascia) to the limbs, trunk, and neck (excluding face and scalp) and with no associated neurovascular or tendon injuries were recruited into the trial. The exclusion criteria used included immunocompromised patients (diabetics, malignancy, renal failure, corticosteroid treatment), primary dermatological conditions (psoriasis, eczema), keloid prone or susceptible patients, and wounds judged unsuitable for primary closure.

Intervention: Skin lacerations were randomly allocated to have closure by either the traditional method or by use of the dynamic sliding loop suture method. The trial had ethical approval of the hospital ethics committee and all participants were fully informed of the trial both verbally and by an information leaflet. Written informed consent was obtained before starting the study.

Main outcome measure: The cosmetic appearance of photographs of wounds immediately after suture removal and at three months were assessed by a general surgeon and an orthopaedic surgeon blinded to the technique used. The 10 point visual analogue cosmesis scale was used for scoring the appearance of the wounds.

Secondary outcome measure: The presence of wound closure related complications such as infection, dehiscence, suture slippage, wound edge submergence, skin edge necrosis, and haematoma formation were noted and recorded on follow up visits.

Results: A total of 37 patients participated in the trial over a period of 18 months. Seventeen patients underwent suture by the traditional technique and 20 by the dynamic sliding loop suture technique. Four patients (all from the traditional group) were lost to follow up and not included in the study. Most wounds healed uneventfully although there was one case of wound infection in each group. Four patients had ligature slippage (three from the dynamic suture and one from the traditional group). Two patients had evidence of skin edge necrosis both from the traditional technique group. A comparison of the healed wounds by two independent assessors blinded to the technique used showed no statistically significant difference observed between the two types of intervention (Wilcoxon matched paired test $p > 0.05$) immediately after suture removal or at three months. Although there was no statistically demonstrable difference, the comparative paired absolute visual analogue scores seemed to consistently show higher values for the sliding loop technique.

Conclusion: The cosmetic appearance of wounds sutured using the dynamic sliding loop suture technique in this study were not statistically shown to be superior to those sutured using the traditional suture technique although absolute visual analogue scores consistently showed higher values for the sliding loop technique. The significance of this is unclear and may warrant a much larger trial to see if it is a trend that a larger population of participants can help to support or refute with regard to the superiority of this new technique.

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Accident and emergency departments in the United Kingdom see an average of 3 million patients with wounds a year.¹ The vast majority of these wounds are sutured by junior staff with limited experience and time in the handling of these wounds. While sutures create conditions for primary healing to take place, inappropriate technique can have adverse effects by increasing infection risk, impairing local circulation, or causing further tissue injury.

Traditional suturing techniques entail creating knots of various descriptions (example reef, granny, half hitch) that need to be tightly secured to prevent slippage and subsequent wound dehiscence. This is critical in areas of the body not accessible to visual assessment of wound healing.

Wound healing is however a dynamic event, which has as part of its process, the development of local tissue inflammation and oedema. Tightly secured traditional knots can (if inappropriately placed in inexperienced hands) cause considerable local tissue tension and possibly compromise the healing process and final cosmetic outcome. Skin sutures readily accessible to visual assessment provide an ideal opportunity to test our new technique of suturing called the dynamic sliding loop suture.

HISTORY

The dynamic sliding loop suture technique was developed on the hypothesis that the suture would adjust its final width

Figure 1

based on local tissue response; maintaining wound edge apposition without increasing local tissue tension. This takes place through a process whereby the interlocked loops gently slide to allow for critical tissue expansion that occurs during early wound healing. An important aspect of the technique is to have sufficient length of free suture available to permit sliding to take place without slippage as will be explained in the technique section. This technique was first taught to the principal investigator by Mr David Bracey, consultant orthopaedic surgeon at the Royal Cornwall Hospital, Trerule, Truro. Although anecdotal experience suggested this technique to have superior cosmetic outcome there have not been any prospective randomised trials that have subjected it to critical evaluation.

TECHNIQUE OF THE DYNAMIC SLIDING LOOP SUTURE (FIGS 1–6)

The key aspect of this technique is the creation of sliding loops with an adequate length of free ends to allow for the sutures to slide yet not slip as they accommodate for wound edge expansion from tissue oedema. Although the wounds sutured in this study were done with the knots overlying the wound, which can occasionally cause inversion of wound edges, the technique can just as easily be applied for suturing with evert ing mattress sutures. It is the presence of the loop and its alignment in the plane of the wound and not the siting of it in relation to the wound edge that defines this technique.

Step 1

The first suture loop that apposes the edges of the wound is exactly like a conventional loop but requires three throws (thrice round the needle holder). It is necessary to use non-absorbable synthetic suture material. The subsequent technique is as described with the following steps with picture illustration (fig 1).

Step 2

Gently slide the throw longitudinally so the two ends of the suture material lie at right angles to the wound and parallel to the skin surface. It is mandatory to work close to the wound without lifting upwards while looping the knots (fig 2 and fig 3).

Figure 2

Figure 3

Figure 4

Step 3

Apply the second throw by coiling suture material twice or three times while strictly maintaining the needle holder along the length of the wound. Avoid making the coil in the same orientation to the first throw (reversal of clockwise or anticlockwise) (fig 4).

Step 4

Slide the throw without knotting but locking on the first throw forming a loop (fig 5).

Step 5

Cut the ends leaving at least 2.5 cm length free on both sides of the loops to prevent slippage (fig 6).

METHOD

This study was carried out over an 18 month period in a district general hospital with an annual attendance of 44 000 patients. The study had hospital ethical approval and was supported by a small grant from the Welsh Office of Research and Development for Health and Social Care.

Figure 5

Figure 6

Procedure

The patients to be recruited were numbered by computer randomisation before study started. They were randomly assigned into two study proforma groups, group A (traditional technique) or group B (dynamic suture technique). The information containing the study proforma, patient follow up clinic appointment card, and patient information and consent sheet was kept sealed in serially numbered white envelopes in a secure area accessible to the study investigators.

Patients

A convenience sample of consecutive patients aged between 16 and 60 with lacerations to the limbs, trunk, and neck (excluding the face and scalp) were approached by the study investigators (consultant and specialist registrar) over an 18 month period to participate in the trial. Wounds assessed at any time to have tendon, nerve, or significant vascular damage were excluded. Exclusion criteria also included wounds deemed unsuitable for primary closure, immunocompromised patients (diabetes, malignancy, corticosteroid treatment, renal failure, cytotoxic treatment), primary dermatological conditions (eczema, psoriasis), and keloid prone wounds.

Patients who consented to participate in the trial after meeting inclusion and exclusion criteria after initial assessment of their wounds were then taken to the departmental minor theatre and handed a sealed envelope containing the proforma that would be used. The technique identified in the proforma was explained and they were given time to read the patient information leaflet and sign the consent form during wound preparation.

The wound was cleaned twice with povidone iodine and a pre-suture photograph was taken. The wound was infiltrated locally with 1%–2% lignocaine (lidocaine) and then sutured by either the principal or co-investigator with 30 or 40 Novofil using the technique advised in the proforma. A post-suture photograph was taken after cleaning and drying and the wound was dressed with non-adherent dressing (telfa or mefix). The patients were then brought back to the suture trial

Table 1 Patient and wound characteristics. Mean (SD) median values

	Traditional 13	Dynamic Loop 2	p Value
Age	39.0 (13.5) 39	37.4 (12.4) 37.5	0.78
Sex (frequencies)			
Male	10	14	0.85
Female	3	6	0.96
Length of wound	3.5 (2.6) 2.7	4.5 (6.2)* 3.0	0.91

*One wound was about 30 cm.

Table 2 Visual Analogue Cosmesis Scale (VASC) (1–10)

	Traditional	Dynamic loop	p Value
Post-suture removal (Time 1). Mean (SD) median values			
Observer 1	6.2 (1.0) 6.0	6.6 (1.3) 6.0	0.53
Observer 2	6.8 (0.9) 7.0	7.5 (0.7) 6.0	0.21
At three months after suture removal (Time 2) Mean (SD) median values			
Observer 1	8.1 (1.8) 9.0	9.2 (0.7) 9.0	0.37
Observer 2	8.9 (1.7) 10.0	9.4 (0.4) 10.0	0.26

review clinic after 10–14 days for removal of the sutures depending on the site of the wound. Pre-suture and post-suture removal photographs were taken at this time. A general description of the wound and noted complications were written on the individual proforma.

A final photograph at three months was taken for the patients who had returned for follow up.

Statistical analysis

The demographic characteristics of the patients, type of surgical intervention, and the length (cm) size of the wounds were summarised with descriptive statistics. Spearman correlations were used to test for the strength of linear association between variables along with the Wilcoxon or Mann-Whitney test when appropriate. Statistical significance was defined as $p < 0.05$. Results were analysed by the SPSS version 10 software package.

RESULTS

A total of 37 patients were recruited into this trial. Seventeen patients underwent suturing by the traditional technique and 20 were sutured using the dynamic sliding loop suture technique. Four patients (all from the traditional group) were lost to follow up and were excluded from the study.

There were 24 men and nine women in the study (table 1). Twenty patients underwent suturing by the dynamic sliding loop technique and 13 by the traditional technique. One patient each from both groups had local wound infection that responded to antibiotic treatment. Three patients from the dynamic sliding loop group and one patient from the traditional group had ligature slippage on follow up review. Two patients from the traditional group had evidence of local skin edge necrosis on follow up review as compared with none in the dynamic sliding loop group.

The 10 point visual analogue cosmesis scale (VACS) assessment of photographs of post-suture removal (T1) and three month (T2) wounds by a general surgeon (Obs1) and orthopaedic surgeon (Obs2) blinded to the technique used demonstrated moderate interassessor agreement at T1 for traditional suture technique ($r = 0.60$, $p < 0.031$: Spearman's correlation) and for the dynamic sliding suture technique ($r = 0.56$, $p < 0.010$: Spearman's correlation); at T2 there was

good interassessor agreement for traditional suture technique ($r=0.91$, $p<0.004$ Spearman's correlation) and for the dynamic sliding loop suture technique ($r=0.71$, $p<0.012$ Spearman's correlation). There was no significant difference observed between the two suture techniques (Wilcoxon's matched paired test $p>0.05$). Although there was no statistically significant difference observed, the absolute value trends consistently show higher values for patients in the dynamic sliding loop suture group (table 2).

DISCUSSION

The management of wounds is as old as the practice of medicine. Ancient Indian texts like the *Susruta Samhita* dating between 800 BC to AD 2nd century describe surgical techniques and suturing as routine practice by skilled physicians of the time.² The standard swaged on needles with the suture incorporated into a hollow in the needle was developed during the second world war.

The aims of primary wound closure are:

- (1) The restoration to cosmetically acceptable pre-trauma anatomy and maintenance of the restored wound.
- (2) Prevention of wound dehiscence by the provision of suture tensile strength while the natural healing process takes place.

These aims come at the intrinsic risk of introducing a foreign material into the natural healing wound. The balance of just enough wound tension to maintain integrity and too much tension causing local wound ischaemia has been a problem grappled by surgeons for generations. A variety of alternative skin closure methods have been developed (tissue glue, tapes, staples, etc) but none to date have been able to completely replace suture.

The dynamic sliding loop suture was developed to achieve precisely this balance required in the apposition of wounds during primary wound closure. The results from this study although not demonstrating statistically significant differences in the cosmetic appearance of the wounds sutured using the two techniques do not show the technique to be any worse. If anything, the raw data comparison consistently shows a trend towards better cosmetic appearance of the wounds sutured using the new technique more so at the three month review of the wounds.

This study's main weakness is its small sample size that renders statistical evaluation of the data difficult. The technique is new and so both the principal investigator and co-investigator had to undertake a short learning curve period, which may explain the suture slippage from loosening of the loops in the early phase of the trial. This did render wounds at risk of dehiscence with possible worse clinical outcome although this was not obvious in the wounds subsequently assessed by the independent reviewers.

Although the technique was used in this trial by senior staff (consultant and middle grade) it is one that is easily taught to more junior members of staff such as senior house officers during induction training suture workshops. A fairly steep learning curve will permit a reasonable level of competence in using the technique. As always, practice makes perfect and this technique is no exception.

The 10 point visual analogue scale used in this study could have been refined to the previously validated 100 point visual analogue scale.

In conclusion, the dynamic sliding loop suture technique of wound closure is one we feel does demonstrate trends towards better cosmetic appearance in the wounds. However, we feel that this technique needs to be further explored in a larger population of patients, with significantly more doctors trained in this suturing technique.

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Contributors

Mr S G Gandham (consultant A&E) initiated the idea for the study from his previous work with Mr David Bracey. He sought research funding, ethical approval, and is the principal investigator in recruitment and data collection. He is guarantor for the paper. Mr Dilip Menon (specialist registrar A&E) worked as co-investigator during his tenure in the department in recruitment and data collection. He collated the data and wrote the final and revised drafts of the paper. Mr Saad Abdullah (specialist registrar A&E) participated in data collection during his tenure in the department. Mr Peter Hobson (Statistician) did the statistical analysis of the data collected. Mr Salah Bastarowous (consultant orthopaedic surgeon) and Mr David Hay (consultant general surgeon) did the blinded assessment of photographs of wounds sutured using the two techniques.

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REFERENCES

- 1 **Heyworth J.** *Wound care.* In: *Cambridge textbook of accident and emergency medicine.* 1st edn. Cambridge: Cambridge University Press, 1997:235.
- 2 **Cule J.** *The history of medicine.* In: Porter R. *Medicine: a history of healing. Ancient traditions to modern practices.* London, Michael O'Mara, 1997:18.