

A comparison of 2-octyl cyanoacrylate with nylon for wound closure of knee arthroscopy portals

- **Objective:** To compare the cosmetic results, complications and patient satisfaction of 2-octyl cyanoacrylate (Dermabond, Ethicon Inc. Somerville, NJ, USA), a liquid bonding agent, with 3-0 nylon sutures (Ethilon, Ethicon Inc) skin closure in two groups of patients undergoing elective knee arthroscopy at 6 weeks.
- **Method:** The retrospective clinical audit recruited patients undergoing knee surgery for the first time between October 2010 and August 2011. The patients were either treated with the liquid bonding agent or nylon sutures. The patients in the bonding agent group were allowed to shower as normal on postoperative day one, while patients in the suture group kept their wounds dry for 2 weeks.
- **Results:** Between the two groups (40 patients per group) there was no difference in the cosmetic outcome ($p=0.285$), patient satisfaction ($p=0.29$), pain scores ($p=0.44$) or wound complication rate ($p<0.05$). Patient satisfaction was high in both groups. Furthermore, 83.75% of all patients indicated they would prefer the liquid bonding closure over nylon sutures if undergoing the same procedure in the future as they could shower the next day and avoid suture removal.
- **Conclusion:** 2-octyl cyanoacrylate is safe to use in the short term in knee arthroscopy providing comparable results to nylon suture closure. Allowing patients to shower the next day appears to cause no adverse effects.
- **Declaration of interest:** The authors would like to state that they do not have any economic or social interest in any of the products used or mentioned. No grant or finance was received for this study, nor any input from other sources.

wound closure; 2-octyl cyanoacrylate; knee; arthroscopy

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Dermabond (Ethicon, Inc., Somerville, NJ, USA), 2-octyl cyanoacrylate, was approved for human use as a topical skin adhesive in 1998 by the US Food and Drug Administration. It forms a waterproof antimicrobial-resistant film, which bonds opposed wound edges, allowing normal healing to occur below. Its use has been studied in various surgical specialties for both primary wound closure and closure of traumatic lacerations. The majority of reports have been in plastic surgery, general surgery, oral and maxillofacial surgery, cardiothoracic surgery and neurosurgery.¹⁻⁵ It has been shown at worst to provide equivalent cosmetic results and patient satisfaction when compared to more traditional methods of skin closure such as staples or sutures.

There are few descriptions of the use of Dermabond in orthopaedic surgery, and so far these have been limited to primary closure of hip and knee arthroplasty wounds.^{6,7} To date, its use in arthroscopic surgery of the knee has not been evaluated.

This clinical audit compares the effect of liquid adhesive with 3-0 nylon sutures (Ethilon, Ethicon Inc, Somerville, NJ, USA) on the closure of skin wounds after knee arthroscopy. We evaluated cosmetic appearance, wound complications, patient satisfaction and cost effectiveness.

Methods

Ethics committee approval was sought and deemed unnecessary for this retrospective clinical audit. No financial aid was received.

Patients waiting for knee arthroscopy, which involved the standard anterolateral and anteromedial portals, were recruited between October 2010 and August 2011. Exclusion criteria were patients under the age of 16 years; patients undergoing open arthroscopically assisted procedures such as anterior cruciate ligament reconstruction; patients with pre-existing infection, inflammatory conditions or metalwork around the knee; and those who had previous ipsilateral knee surgery.

All patients were operated on by the senior author (JPM) or by AI or AR with JPM supervising. All surgeons were trained in the use of the liquid adhesive and had completed a minimum of three closures with this method before starting the audit to eliminate bias. Moreover, all surgeons had extensive use of interrupted nylon closure for knee arthroscopy portals. An above-knee tourniquet was used in all cases, and inflated to 300mmHg after exsanguination of the limb. Post procedure, all knees were infiltrated with 20ml bupivacaine 0.25% into the joint and soft tissues for postoperative pain relief just after wound closure.

When using liquid adhesive, the technique used was as advised in the manufacturer's product information booklet. Good haemostasis was achieved, the wound was dried, and the edges brought together by pulling at the apex of the wound with a pair of Adson fine-toothed forceps. The single 0.5ml vial containing the liquid adhesive was crushed and applied onto the wound in multiple thin layers. The edges of the wound were held together for 10 seconds with the Adson forceps, and then a second more generous layer was applied on top of the first. No outer dressing was required but an OpSite (Smith & Nephew, Memphis, TN, USA) postoperative transparent waterproof dressing was used to minimise patient anxiety after surgery with soft wool and crepe bandage over the top to provide compression. The tourniquet was deflated at this stage and patients sent to the recovery room. Before discharge, the same day, the wool and crepe bandage was removed and exchanged for a Tubigrip bandage ((Mölnlycke Health Care, Ontario, Canada). The patients were instructed that they could remove the OpSite dressings after 24 hours and briefly shower the operated knee if they wished to. They were asked, however, not to swim or bathe to avoid submerging the incision under water for a prolonged period of time, or scrub the wounds in keeping with the manufacturers guidelines.

All aspects of the intraoperative and postoperative care were identical for both study groups. On discharge from hospital, patients in the suture group were instructed to keep the waterproof dressing on and keep the affected knee dry until the sutures were removed in the outpatient clinic 2 weeks after surgery.

Patients in both groups were followed up at 2 weeks where they were reviewed by AI and AR to check for early complications but cosmetic outcome was formally assessed at 6 weeks by AI and AR using the Modified Hollander Wound Score scale.^{1,3,8} This is a validated tool for standardisation of wound surveillance with grading of six cosmetic categories. The categories include step-off borders, contour irregularities, scar width, excessive inflammation, edge inversion and overall cosmetic appearance. For each category, a score of 0 or 1 was assigned, and the total score combined. For purposes of this study, a score greater than 0 reflected a suboptimal cosmetic result. Patients were then asked to complete two 100mm visual analogue scales⁹ for cosmetic appearance of the wounds and for pain. For cosmetic appearance 0 indicated the worst outcome and 100 the best, while the reverse applied for pain with 0 the best outcome and 100 the worst.

Patients in the liquid adhesive group were asked to confirm if they had been able to shower on postoperative day one. They were then shown a picture of an arthroscopy wound closed with 3-0 nylon and

Table 1. Patient demographics

| | Liquid adhesive (n=40) | Nylon sutures (n=40) | p-value | All patients (n=80) |
|---------------------------|------------------------|----------------------|---------|---------------------|
| Mean age in years (range) | 51.34 (22–87) | 54 (25–81) | 0.8* | 70 (22–87) |
| Gender (%) Male:Female | 23:17 (58:42) | 23:17 (58:42) | 1.0** | 46:34 (58:42) |

*t-test

**chi-squared test

informed of the postoperative course including suture removal. They were then asked which of the two methods of closure they would prefer if having a similar operation in the future.

Patients in the suture group were shown a picture of an arthroscopy wound closed with liquid adhesive. They were informed that showering would be permitted the day after surgery and there would be no need for suture removal or dressings. They were then asked which of the two methods of closure they would prefer if having a similar operation in the future.

Statistical analysis

Analysis was carried out using SPSS version 12.0 (SPSS Inc, Chicago, Illinois). The Kolmogorov-Smirnov test was used to determine whether continuous variables were normally distributed. Skewed data were presented as medians and normally distributed data as means.

The Mann-Whitney U test was used to compare non-parametric data between the two groups. The student's t-test was used to compare parametric data between the two groups. The chi-squared test was used to make comparisons between the two groups for categorical variables.

Results

A total of 80 knees in 80 consecutive patients undergoing elective knee arthroscopy (34 women and 46 men) were evaluated. Forty patients had their arthroscopy portals closed by the liquid adhesive and the remaining 40 patients had their arthroscopy portals closed with a single interrupted 3-0 nylon suture.

Sixty-one (76%) patients had an arthroscopic meniscectomy, 17 (21%) had a diagnostic arthroscopy and two (3%) had an arthroscopic synovectomy. The 40 patients offered wound closure with the liquid adhesive were all informed of its novel use in knee arthroscopy, given written information about the product and given the option of wound closure with nylon suture if they had concerns. All of these patients were happy to proceed with the treatment.

The mean age of the patients in the liquid adhesive group was 51.34 years (22–87). The mean age of the patients in the suture group was 54 years (25–81).

Eighty patients were reviewed over the 11-month period. Table 1 shows the patient demographics. There was no statistically significant difference between the two groups in terms of age or gender.

There were no incidences of wound complication such as infection or oozing in either group at the 2-week or 6-week follow-up visits. None of the 80 patients were lost to follow up.

Surgeon outcomes

All wounds were evaluated on day 14 postoperatively by one of the operating surgeons using the Modified Hollander Wound Score scale.⁸ Assessment of step-off borders, contour irregularities, margin separation, edge inversion, and excessive distortion were recorded (Table 2). Of the liquid adhesive patients, 37 (92.5%) scored 0 reflecting an optimal cosmetic result compared to 34 (85%) of the nylon patients. Two (5%) of the liquid adhesive patients had a score of 1 compared to 4 (10%) of the nylon patients. One patient in the liquid adhesive group had a score of 3 (2.5%), while the remaining 5% of the nylon patients had a score of 2. The results between the two groups were not found to be statistically significant (p=0.285).

Patient outcomes

There was no statistically significant difference in the patient satisfaction visual analogue scale (VAS) score at 6 weeks between the two groups (p=0.29), or the patients' pain VAS score (p=0.45). Patients in both groups gave high satisfaction and low pain scores (Table 3).

Of the 40 patients in the nylon group, however, 30 (75%) stated a preference for liquid adhesive over nylon sutures if having a similar procedure in the future. Of the 40 patients in the liquid adhesive group, 37 (92.5%) stated they would prefer the surgeon to use liquid adhesive over nylon sutures if having similar surgery in the future.

Of the 40 patients in the liquid adhesive group, 32 (80%) had a shower the day after surgery with no adverse effects. Two (5%) patients did not feel comfortable getting the wound wet so soon after surgery

and 6 (15%) were told to keep the wounds dry for 2 weeks in error by allied health professionals who had not been briefed about the study or educated on the use and benefits of liquid adhesive.

Discussion

Liquid adhesive use for primary wound closure appears to be growing in popularity in other surgical specialities, with reported benefits including ease of use, reduced operative time and high patient satisfaction.¹⁰⁻¹⁶ Although it appears to provide a safe method of skin closure, caution has been advised over large incisions and over areas of high-tensile stress that are mobile.^{6,15} Its use in orthopaedic surgery has been limited mainly to lower limb arthroplasty^{6,7,17,18} and more recently paediatric nail bed injuries.⁴

Patients appreciate being allowed to shower the day after surgery.¹⁹ They do not have to undergo a follow-up visit to have the sutures or clips removed as the protective film sloughs off the incision site between 5 and 10 days after surgery. In certain instances, clip removal in particular can be uncomfortable for patients.²⁰

The cost of one 0.5ml vial of liquid adhesive, which is sufficient to close knee arthroscopy portals, is £16.65, compared to a pack of 3-0 nylon (Ethilon) which costs £1.91. The absence of repeat follow-up appointments²¹ may offset the higher cost of liquid adhesive compared to a packet of nylon sutures.²² Currently, primary care trusts in the NHS pay hospital trusts for 1.5 follow-up visits per patient in the orthopaedic outpatients clinic at a rate of £99.10 per visit. Reducing the outpatient attendance of each patient by at least one visit for a wound check or removal of sutures or clips at 2 weeks could make liquid adhesive use in knee arthroscopy a cost-effective option. However, the patient would still require a 6-week check, which is common in most orthopaedic practice after arthroscopy, to ensure knee function is improving and preoperative symptoms have resolved.

In addition to providing comparable results to nylon closure in terms of patient satisfaction and cosmetic result, the risk of needlestick injury to the operating surgeon is eliminated as no suture needles are required.²³

Arthroscopy portals closed with liquid adhesive appeared to retain the local anaesthetic volume infiltrated into the knee postoperatively as effectively as those closed with nylon. This was not measured either directly or indirectly with immediate postoperative pain scores in this study.

In general, wounds from knee arthroscopy portals heal well whichever method of closure is used, and this includes the use of simple sterile waterproof dressings with or without the use of Steri-Strips (3M, St.Paul, Minnesota, USA). Certainly this practice has demonstrated comparable clinical outcomes and

Table 2. Modified Hollander Wound Score Scale: Cosmetic appearance

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|--|------------|---------|---------|----------|-------|-------|-------|
| Liquid adhesive Number of patients (%) | 37 (92.5) | 2 (5) | 0 (0) | 1 (2.5) | 0 (0) | 0 (0) | 0 (0) |
| Nylon suture Number of patients (%) | 34 (85) | 4 (10) | 2 (5) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Total number of patients (%) | 71 (88.75) | 6 (7.5) | 2 (2.5) | 1 (1.25) | 0 (0) | 0 (0) | 0 (0) |

Between groups p=0.285 (chi-squared test)

Table 3. Visual analogue scale (VAS) outcomes at 6 weeks

| | Liquid adhesive (n=40) | Nylon sutures (n=40) | p-value |
|---|------------------------|----------------------|---------|
| Median patient satisfaction VAS (range) | 95 (70–100) | 95 (75–100) | 0.29* |
| Median patient pain VAS (range) | 20 (12–30) | 21 (14–30) | 0.44* |

*Mann-Whitney U-test

cost when compared with wound closure using sutures.^{24,25} Despite this, there is still no consensus on how arthroscopy portals should be closed with some clinicians advocating the combined use of sutures, Steri-Strips and waterproof dressings. This audit demonstrates that liquid adhesive may be another viable wound-closure option, not previously described for this type of surgery that clinicians can consider for their patients.

Limitations of the audit include the fact that patients were not randomised into groups and neither the clinicians nor patients were blinded to either treatment arm. There was a relatively small number of patients in each group, and hence there is a possibility of not finding a statistically significant difference between the two groups when a true difference exists (type 2 error). We recommend a larger, appropriately powered, prospective, randomised,

blinded research study with longer follow-up to overcome these limitations.

Despite our efforts, it proved difficult to make all staff involved in the immediate postoperative care of patients in the liquid adhesive group aware that showering the next day was safe. This is different to the standard postoperative wound care advice they are instructed to give orthopaedic patients in our unit at present.

Conclusions

This clinical audit indicates that liquid adhesive use in knee arthroscopy is safe and achieves comparable results to nylon sutures in the short term. Its main advantage is that patients can shower after 24 hours with no adverse effects. Patients potentially do not require postoperative dressings or an extra outpatient follow-up appointment at 2 weeks for a wound check. Though this was not confirmed by our study, it could form the basis of a further study, along with a more detailed cost analysis. Comparison of liquid adhesive to wound closure with Steri-Strips or simple sterile waterproof dressings alone would also be a useful further study, as the latter methods are cost-effective and do not require suture removal nor potentially an extra outpatient follow-up appointment. ■

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