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# A Prospective Comparison of Octylcyanoacrylate Tissue Adhesive and Suture for the Closure of Head and Neck Incisions

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**Abstract**

*Objective:* To compare the tissue adhesive octylcyanoacrylate with subcuticular suture for the closure of head and neck incisions.

*Design:* A prospective comparison with a blinded assessment of cosmetic outcome.

*Subjects:* Fifty consecutive patients undergoing head and neck procedures at two University of Ottawa teaching hospitals.

*Methods:* Twenty-six patients underwent skin closure with monofilament suture and 24 were closed with tissue adhesive. At 4 to 6 weeks the incisions were evaluated with a validated wound scale. Photographs of the incisions were rated using a visual analogue scale by two facial-plastic otolaryngologists who were blinded to the method of skin closure.

*Results:* The adhesive provided faster skin closure (29.7 seconds vs 289.0 seconds, $p < .0001$), and there were no differences in complications between the two groups. The primary outcome measure was the cosmetic appearance of the incision at 4 to 6 weeks. Although the adhesive group scored higher on both cosmesis scales, the visual analogue scale (octylcyanoacrylate 58.7 mm vs suture 53.2 mm) and the wound evaluation scale (57% vs 50% optimal wound scores), there were no statistical or clinically significant differences on either scale. The two facial-plastic otolaryngologists had good intraobserver and inter-observer agreement when rating the cosmetic outcomes (0.87 and 0.71 respectively).

*Conclusions:* Octylcyanoacrylate was found to be an effective method of skin closure in clean head and neck incisions. The practical advantages of tissue adhesives are reviewed.

**Sommaire**

*Objectif:* Comparer la colle tissulaire octylcyanoacrylate avec la suture sous-cuticulaire pour la fermeture des incisions cervico-faciales.

*Concept:* Une comparaison prospective avec évaluation à l'aveugle du résultat esthétique.

*Sujets:* Cinquante patients consécutifs subissant une opération cervico-faciale dans deux hôpitaux d'enseignement de la University of Ottawa.

*Méthodes:* Vingt-six patients subirent une fermeture de la peau avec une suture de monofilament et 24 furent refermés avec une colle tissulaire. À 4 et 6 semaines, les incisions furent évaluées selon une échelle validée de plaie. Les photographies des incisions furent évaluées en employant une échelle analogue visuelle par deux oto-rhino-laryngologistes-plasticiens de la face qui ignoraient la méthode de fermeture de la peau.

*Résultats:* La colle apporta une fermeture plus rapide de la peau (2.7 secondes vs 289.0 secondes, $p < .0001$) et il n'y a pas eu de différences dans les complications entre les deux groupes. La mesure principale du résultat fut l'apparence esthétique de l'incision de 4 à 6 semaines. Même si le groupe "colle" a obtenu un pointage plus élevé tant dans l'échelle d'esthétique que dans l'échelle analogue visuelle (octylcyanoacrylate 58.7 mm vs suture 53.2 mm) et l'échelle d'évaluation de la plaie (57% vs 50% du pointage optimal de plaie), il n'y avait pas de différence clinique ou statistique significative dans l'une et l'autre échelle. Les deux oto-rhino-laryngologistes-plasticiens de la face eurent une bonne entente intra- et inter-observateurs quand ils pointèrent les résultats esthétiques (0.87 et 0.71 respectivement).

*Conclusion:* L'octylcyanoacrylate s'est avérée une méthode efficace de fermeture de la peau dans les incisions propres cervico-faciales. Les avantages pratiques des colles tissulaires sont revues.

**Key words:** head and neck, incision closures, octylcyanoacrylate tissue adhesives

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Since their adhesive properties were realized in 1959, there has been interest in the use of cyanoacrylates for surgical procedures.[1] Advantages of tissue adhesives for incision and laceration include quick application, excellent cosmetic results, patient preference, and cost effectiveness.[2–4]

Cyanoacrylate adhesives polymerize in an exothermic reaction on contact with a fluid or basic medium to form a strong bond. During the 1960s and '70s, they underwent investigation as tissue adhesives. Shorter chain cyanoacrylates were found to be tissue toxic, and the longer chain n-2-butylcyanoacrylate was believed to be the ideal adhesive causing no tissue toxicity.[5,6] It has been used in Canada and Europe for over 20 years with no adverse effects reported when used for topical skin closure.[7]

Butylcyanoacrylates are currently the only commercially available tissue adhesive for skin closure. Although they are effective at closing superficial lacerations under low tension, they do have several limitations. Several studies have shown wound-breaking strength to be equal to suture-repaired wounds at 5 to 7 days, but that the day 1 breaking strength is only about 10% to 15% of that of a 5-0 monofilament-sutured wound. After polymerizing, the adhesive becomes brittle and is subject to fracturing if used in skin creases or on long incisions. This restricts the adhesive to areas of low tension limiting their use for incision repair.[8,9]

Octylcyanoacrylate is a new tissue adhesive designed to address the limitations of the butylcyanoacrylates. This longer chain cyanoacrylate contains plasticizers and forms a strong flexible bond. Its three-dimensional breaking strength is three times that of n-2-butylcyanoacrylate, and closer to that of a 5-0 monofilament suture.[10] This stronger, flexible bond may allow its use on longer incisions. The new adhesive has been approved by Health Canada as a medical device for topical skin closure. It has also been approved for clinical investigation by the United States Food and Drug Administration.[11]

The purpose of this study was to compare the cosmetic outcome and complication rates of clean head and neck incisions closed with this newly developed octylcyanoacrylate tissue adhesive to those closed with conventional monofilament suture methods.

## Materials and Methods

### Study Population

Fifty consecutive patients who underwent clean head and neck procedures over a 4-month period were prospectively enrolled in the study. Their incisions were closed by one of two senior residents working at separate teaching hospitals of the University of Ottawa (Ottawa Civic Hospital and Ottawa General Hospital). Exclusion criteria included previous radiation to the surgical site, the use of flaps or grafts, immunodeficiency, coagulopathy, and preoperative surgical site infection.

### Procedures

All eligible patients were prospectively enrolled and informed consent was obtained. One senior resident closed consecutive eligible patients with running subcuticular 4-0 or 5-0 monofilament. A dry dressing was applied. Another senior resident trained in octylcyanoacrylate application closed consecutive eligible patients with the tissue adhesive and no dressings were used. Subcutaneous, interrupted 3-0 vicryl was used in both groups. Jackson-Pratt or Hemovac drains were used when indicated and brought out below the incision. Prophylactic antibiotics were used for maxillectomy cases only. Patients were booked for routine postoperative appointments and sutures were removed in 7 to 10 days. Tissue adhesive was removed by the patient or surgeon in 7 to 10 days.

### Outcome Measures

**Time.** Time of the procedure was recorded by the resident.

**Early Complications.** A 7-day phone follow-up was done by the primary author (J.M.) on all patients to assess for the presence of early complications (infection or dehiscence) in addition to the routine appointment with their surgeon. The presence of spreading erythema, discharge, dehiscence, and antibiotic use were recorded.

**Cosmesis.** Patients were seen at 4 to 6 weeks postoperatively for wound evaluation and photographs by one research nurse. The incisions were rated using the Hollander Wound Evaluation Scale (HWES).[12] The score addresses six clinical variables: step-off borders, contour irregularities, scar width, edge inversion, excessive inflammation, and overall cosmetic appearance. Each of these categories is graded on a 0- or 1-point scale. A total cosmetic score is derived by the addition of the scores of the six categorical variables. A score of 6 is considered optimal, while a score of 5 or less suboptimal. The percentage of wounds from each group attaining optimal cosmesis were compared.

Photographs of the incisions were then taken in a standard fashion using an 8:1 macro setting with a ring flash and 100 ektachrome slide film.[13] At the completion of the study, the photographs of the incisions were rated twice by two facial plastic otolaryngologists, blinded to the method of skin closure, on a visual analogue scale (VAS). The VAS is a 100-mm line, with 0 representing the worst cosmetic outcome possible, and 100 representing the best possible result. Using the line as a continuous entity, the physician marks the line where he feels the scar fits. The score is then measured in millimetres from the 0 point.[14]

### Statistical Analysis

The distribution, proportion, and descriptive statistics of all outcomes were considered. For the primary outcome (VAS cosmesis scores) and other continuous outcomes, the treatment groups were compared by a *t* test for independent samples using the pooled or separate variance estimates as appropriate (depending on variance homogenicity). If necessary, based on the distributional properties of the outcomes, nonparametric procedures were used. In particular, the Mann-Whitney test was implemented to compare the treatment groups. For dichotomous outcomes, chi-squared techniques were used; Fisher's Exact Test was used where appropriate. Interclass correlation coefficients with 95% confidence intervals (95% CI) were used to determine physician agreement on the VAS cosmesis scale.

## Results

Telephone follow-up data were available for all 50 patients, and 44 patients returned for the wound evaluation and photograph at 4 to 6 weeks. There were no differences in patient demographics with regard to age, sex, race, length of incision, or surgical procedure (Tables 1 and 2). Tissue adhesive skin closure was faster than suture (27.9 vs. 289.0 seconds, $p < .0001$). There was no statistically significant difference in the VAS cosmesis scores (tissue adhesive 58.7 vs. suture 53.2, $p = .44$) or in the percentage of wounds with optimal scores on the HWES (tissue adhesive 56.5% vs. suture 50.0%, $p = .67$). There was a high level of agreement between physicians rating the incisions on the VAS cosmesis scale [intraobserver agreement = 0.87 (95% CI 0.78–0.93), interobserver agreement = 0.71 (95% CI 0.52–0.84)].

There were five patients in the adhesive group and four in the suture group who were treated with antibiotics. This included one maxillectomy patient in each group, two patients in each group who developed spreading erythema, and two parotidectomy patients in the adhesive group and one in the suture group who developed salivary fistulas. The dehiscent areas of the fistulas were all tiny, and each closed spontaneously by 4 to 6 weeks. One keloid scar occurred in each group.

## Discussion

Cyanoacrylate adhesives have been used for several decades in a variety of clinical settings.[15,16] Butylcyanoacrylates have been used successfully for topical skin closure and have been approved for this indication in Canada since 1980 with no adverse reports.[2,3,6,7] Foreign-body reactions have been reported to occur when cyanoacrylates have been implanted, which seems more likely to occur when implanted in vascular areas.[17,18] There have been no reports of toxicity or carcinogenicity when these adhesives were used topically.[19]

**Table 1** Patient Demographics for the Two Study Groups

| *Feature* | *Tissue Adhesive (n = 24)* | *Sutures (n = 26)* |
|---|---|---|
| Mean age (yr) (SD) | 50.6 (16.3) | 50.2 (19.9) |
| Mean length (cm) (SD) | 8.8 (4.8) | 9.9 (5.8) |
| Mean days until follow-up | 35.1 (6.2) | 34.8 (6.2) |
| % female | 58% | 42% |
| % non-Caucasian | 25% | 27% |

The major limitations of butylcyanoacrylates include low early breaking strength and a brittle consistency when dry, allowing it to fracture when used over skin creases.[8,9] These problems have restricted the use of butylcyanoacrylates to low-tension areas. Kamer and Joseph[2] and Ellis and Shaikh[6] both reported on the successful use of butylcyanoacrylate to close cosmetic incisions under low tension and limited length, such as blepharoplasty incisions.[2,6] The new octylcyanoacrylate adhesive used in this study has a three-dimensional breaking strength that is three times that of n-2-butylcyanoacrylate and closer to that of a 5-0 monofilament suture.[10] It contains plasticizers that help form a flexible bond that prevents fracture. This study is the first clinical trial using octylcyanoacrylate for closure of surgical incisions.

All wounds had deep layers closed with 3-0 vicryl to remove skin tension and to align wound edges. This was standard practice prior to this study, and likely has an important impact on overall cosmesis. However, it is important to note that other than the method of skin closure, the rest of the wound closure was the same for the two groups. Consecutive, clean, head and neck incisions, regardless of site or length, were closed with no difference compared to conventional suture closure. Thus, it is apparent from this study that the added strength and flexibility of the octylcyanoacrylates can broaden the indications for the use of tissue adhesives as an effective alternative to sutures for the closure of clean head and neck incisions closed without flaps or grafts. Although contaminated wounds and

**Table 2** Sites of Operative Incisions for the Two Study Groups

| *Site* | *Tissue Adhesives (n = 24)* | *Sutures (n = 26)* | *Total (%) (n = 50)* |
|---|---|---|---|
| Thyroid | 7 | 5 | 12 (25%) |
| Parotid | 5 | 5 | 10 (20%) |
| Cyst* | 3 | 5 | 8 (16%) |
| Sub† | 1 | 4 | 5 (10%) |
| Neck dissection | 2 | 2 | 4 (8%) |
| Lymph node | 3 | 1 | 4 (8%) |
| Thyroplasty | 2 | 2 | 4 (8%) |
| Maxillectomy | 1 | 1 | 2 (4%) |
| Neck exploration | 0 | 1 | 1 (2%) |

*Thyroglossal duct, branchial cleft, or dermoid cyst excision.
†Submandibular or submental mass excision.

previously radiated beds were excluded for this initial study, octylcyanoacrylate may prove useful in these head and neck patients.

Cyanoacrylate adhesives also have antimicrobial properties against gram-positive organisms and may decrease wound infections.[20,21] As a waterproof dressing with antimicrobial effects, octylcyanoacrylate may be beneficial in closing wounds with stomas and fistulas, and its application to ischemic skin flaps may avoid the further trauma of skin suturing. We have also found it useful as an adjunct to subcuticular sutures in the closure of local flaps under tension.

Although not a randomized trial, this is a prospective study using consecutive eligible patients closed by two senior residents with identical training, each striving for the best possible cosmetic results in their series. There was excellent homogeneity between groups in patient demographics (Table 1) and procedures performed (Table 2). There was no significant difference in antibiotic use or complications between groups. Two scales were used to evaluate cosmetic outcome, with the VAS being a blinded outcome measure. There was no statistically significant difference in either cosmesis scale between the adhesive or suture groups. This study also had enough power to detect any important clinical differences (Table 3). There was sufficient power to discriminate an 11-mm difference on the VAS scale. Prior to the study, it was estimated that a clinically important difference on the VAS was 12 to 15 mm, and therefore, this was used to calculate our sample size.[14]

A review of the surgery literature revealed a lack of objective measures of cosmetic outcome to compare surgical wounds, and is replete with very subjective outcomes such as surgeons' opinions and patient satisfaction.[2,6] The scales used for this study have been proven to be valid outcome measures of cosmesis in laceration repair.[12,14] To validate the VAS use in this study, two facial plastic otolaryngologists rated the photographs at two separate times, with good interobserver and intraobserver reliability. Furthermore, the optimal scores on the HWES were, on average, 18-mm greater than those with suboptimal scores, demonstrating good internal validity and affirming the use of 15 mm as a clinically important difference on the VAS cosmesis scale. Similar methods have been undertaken to validate and determine clinally important differences on VAS pain scales.[22] Thus, it appears that both scales are valid methods of the cosmetic outcome of incisions in head and neck surgery.

We also plan to use these scales to further evaluate the cosmetic outcomes of the patients at 1 year. There has been no study that has correlated short- and long-term cosmetic outcomes of healed incisions. However, we do not expect any differences between the suture and tissue adhesive groups, since there are no histologic differences in their mechanism of wound repair.[5,8,23]

Tissue adhesives have several practical advantages over suture. They offer a faster method of wound closure, and they form waterproof dressings. Therefore, patients can shower immediately, although soaking and scrubbing should be discouraged for 7 to 10 days. A postoperative visit for suture removal is also not required, as the octylcyanoacrylate adhesive can be removed by the patient with soap and water or Vaseline ointment in 7 to 10 days. Postoperative visits can be deferred, therefore, until a more convenient time, which is very practical for patients living significant distances away or for those who are poorly mobile.

Finally, tissue adhesives have been shown to be significantly more inexpensive than suture in the repair of lacerations, and they are preferred by patients[4] Tissue adhesives may decrease costs of surgical care, since dressings are unnecessary and postoperative visits may be decreased. A cost analysis will be required when this new octylcyanoacrylate adhesive is commercially available.

**Table 3** Clinical Outcomes for the Two Study Groups

| *Outcome* | *Tissue Adhesive (n = 24)* | *Suture (n = 26)* | *p* |
|---|---|---|---|
| Mean VAS cosmesis score (mm) | 58.7 | 53.2 | .44 |
| % Optimal wound scores | 56.5 | 50.0 | .67 |
| Mean time of repair (sec) | 27.9 | 289.0 | < .0001 |
| Cellulitis | 2 (8.3%) | 2 (7.7%) | 1.0 |
| Fistula | 2 (8.3%) | 1 (3.8%) | .60 |

## Conclusions

The tissue adhesive octylcyanoacrylate is an effective and reliable method of skin closure in clean head and neck incisions, yielding similar cosmetic results to closure with subcuticular monofilament suture. Octylcyanoacrylate is a faster method of skin closure than suture, and offers several practical advantages over suture repair.

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