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Tissue Adhesives

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Tissue Adhesives

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Abstract

The goal of this paper is to summarize the best available evidence comparing tissue adhesives and traditional suture in the repair of traumatic lacerations in children. As providers caring for children, we want an efficient method of laceration repair that has the best cosmetic outcome. We want a repair without complications and to minimize the amount of pain and anxiety experienced by our patients and families. Numerous peer-reviewed, published studies have found that when used appropriately tissue adhesives are faster, less painful, and more economic than traditional suturing. Patients have fewer complications, reduced risk of infection, and excellent cosmetic outcomes. Overall the evidence suggests that using a tissue adhesive is a cheaper method of laceration repair and results in greater satisfaction for both the patient and the practitioner. Based on these comparisons, an evidenced based decision should be made.

Introduction

Simple traumatic lacerations are a leading cause for pediatric patients to present to the emergency department. The highest incidence of accidental lacerations in children occurs between the ages of two and four. “Traditionally, suturing has been the standard of care in repairing lacerations.” (King & Kinney, 1999, p. 66). The initial injury creates a heightened level of stress in both the parent and child. A painful repair will only serve to compound the emotions involved. The resources, which minimally include staff, material and bed space to do a quality repair, are often a drain on the healthcare setting, whether in a primary care clinic or an emergency department. Often additional resources are needed. The pediatric patient in need of suturing, especially of a facial laceration, will ultimately require some level of restraint or sedation. Specialized training for the provider is needed to ensure good cosmetic outcome.

Although primary providers are often trained to do simple laceration repairs, the time and resources needed to complete the repair are often not available in the patient’s primary healthcare clinic. Research suggests that tissue adhesives are equivalent to traditional suturing for cosmetic outcomes, take much less procedural time, and cause virtually no pain. In addition, decreased risks of infection and expense have been found when tissue adhesives are used. Finally, there is limited training needed to use the product correctly and with confidence. The goal of this paper is to explore the evidence supporting the validity of those claims.

Identification of the Issue

Background:

Lacerations are one of the top ten chief complaints that pediatric patients present with to an emergency department (Farlon et al., 2009). In one study over four percent of patients presenting to a busy urban emergency room had a simple linear facial laceration less than 2 cm

in length (Singer, Kinariwala, Lirov, & Thode, 2010). Children with lacerations pose many challenges. They often require sedation to reduce pain, emotional distress and movement during the procedure. This adds time, expense, and complexity to the patient's care. In the current healthcare system the luxuries of extra time or resources rarely exist. Additionally, both the child's parents and healthcare providers worry about scarring. One of the primary goals of wound management is optimal cosmetic outcome, which becomes even more important when considering facial lacerations. "The final appearance of the scar is the primary concern of patients, making this the most important clinical outcome" (Holger, Wandersee, & Hale, 2004, p. 254).

Techniques to repair lacerations have been around for thousands of years. The first ones documented were in Egypt and consisted of twine, wool, silk, hair and Bengal ants. The nylon suture came out in the 1930's and is still used in many settings. The absorbable types of suture material were introduced in the 1980's (Trott, 2005). Tissue adhesives, were first introduced in early 1950's, are currently one known alternative to traditional needle and thread (King & Kinney, 1999). There have been many studies done on the benefits to both the healthcare system and the patient with the use of alternatives to traditional sutures.

Unfortunately, for many providers when faced with a repair, very little has changed in their practice. Choice is based on experience instead of research and best practice. This is a common problem; doing what has always been done instead of making a change when evidence proves that a change should be made. A variety of barriers prevent providers from taking advantage of what research has proven to be in the best interested of their patients. A consortium at the University of Iowa published an article looking at these barriers, "An estimated 19% of medical practice was based on science and the rest on "soft-science" or opinions, clinical

experience, or tradition” (University of Iowa, 2003, p. 3). As pediatric providers, we owe our patients more.

An informal survey of twenty providers, practicing at either Children’s Hospital emergency department or Stillwater Medical Clinic, experienced and skilled in laceration repair revealed that although all were aware of the current research, many continue to feel that using a tissue adhesive is a substandard. The overwhelming belief expressed is that glue is simply an easy way to avoid suturing a problematic toddler (Staff Children’s ED & Staff Stillwater Medical Clinic, personal communication, Winter, 2011). This belief supports the concern that research has not transitioned into practice at the bedside. The reality is that the immediate benefit of tissue adhesives for the patient is the pain free experience. The long term benefit is an excellent cosmetic outcome. The benefit for the healthcare system is reduced infection, improved patient satisfaction, and decreased expense with time and resources saved.

Wound Healing:

It is important for a provider, who is managing the care of a patient presenting with a traumatic laceration, to understand the process of wound healing. The stages of wound healing begin with an inflammatory response. Swelling occurs immediately following the injury. Blood flows into the area bringing white blood cells, antibacterial proteins, and other compounds aimed at repairing the integrity of the skin (Tortora & Derrickson, 2009). Granulocytes and lymphocytes begin killing and consuming bacteria and other debris within the wound. Approximately over the next twenty four hours macrophages move in. The resulting influx of material into the wound strains the local environment, resulting in hypoxia, increased carbon dioxide and lactic acid production which activate even more chemical and cellular responses

(Trott, 2005). For this reason, knowledgeable providers would be hesitant to close a wound by primary intention beyond twenty four hours.

As epithelization begins; cells haphazardly fill in and create a bridge to close the wound (Tortora & Derrickson, 2009). Intact cells at the wound edge undergo changes that facilitate cell migration. Replication takes place and cells begin to move over the surface along fibrin strands. Cells from the opposite edges of the wound meet and connect. Lining up the layers and approximating the wound edges with the same type of cells is essential for proper wound healing. This provides strength and minimal scar formation; in essence this means dermis to dermis and epidermis to epidermis.

Fibroblasts lay down a bed of collagen which provides the infrastructure of the wound healing. Fibroblasts appear in the repair of wound by the third day; these are the cells which lay down a connective tissue matrix becoming collagen (Trott, 2005). If left to repair itself, new collagen is deposited in a random pattern with little tensile strength. Enzymes are excreted that break down old collagen; if new collagen synthesis does not keep up with breakdown, the tissue pulls apart increasing the appearance of scar formation (Trott, 2005). Approximating the wound edges prevents excess collagen production and the repair will then have strength.

Wounds heal by primary, secondary or tertiary intention (Trott, 2005). Primary intention is suturing or using tissue adhesives to bring the edges together. Bringing the wound edges in close proximity allows for angiogenesis and minimizing the amount of granulation tissue that is deposited into the wound (Trott, 2005). Ultimately, if we did nothing the body would repair itself. Our goal is to aid and not interrupt the process. It is most important to have an understanding of skin anatomy and then choosing the closure technique that will be best to enhance, not hinder natural healing.

Options for Primary Closure

Suture:

When closure of a wound is necessary the provider should have a basic understanding of the options that will give the optimal outcomes. Areas of high tension, such as over a joint, should be repaired with suturing. Traditional suture materials come in a variety of sizes and strengths; there is absorbable and non absorbable. Some materials are meant to be used on fine skin, such as the eyelids and some material meant for thick skin, such as the back (Trott, 2005). The variety creates a need for specialized training for a provider to achieve a level of competence in choosing and working with suture materials. Several complications can result from improper technique or material choice. The use of a large bore suture material in a wound that should be repaired with something finer creates more tissue trauma and a less favorable cosmetic outcome. Tight sutures strangulate wound edges creating necrosis which could lead to infection, resulting in greater scarring. Likewise, loose sutures result in gapping, increased collagen deposits, and promote infection (Trott, 2005).

After the laceration has been repaired, ongoing care is necessary. Care includes gently cleaning off initial scab, application of ointment daily, and timely suture removal. All are necessary for optimal healing. This involves a caregiver able and willing to meet these needs. Many patients return for suture removal several days past the recommended time; the result is collagen deposits within the holes created by the suture material. Scars are then seen in every entrance and exit hole along the repair. This is referred to as “railroad tracks”. Another frequent problem is initial scabs left intact; the suture material gets imbedded into the scab and removal is very painful and the result is increased scar formation.

Tissue adhesives:

Tissue adhesives were first introduced in the 1950s (Trott, 2005). The early ones were friable and degenerated much too quickly. The originals were “short alkyl chains which lead to rapid degeneration into toxic compounds, causing inflammation” (King & Kinney, 1999, p. 66). A newer product cyanoacrylate, which is a long alkyl chain compound, has been shown to have greater strength and flexibility. It binds to skin surfaces with a polymerization reaction, which strongly bonds over the approximated wound edges (Farlon et al., 2009). They have good tensile strength, are bacteriostatic, and flake off after healing has occurred (Zempsky et al., 2004). Lacerations over low tension sites, such as the face, can be effectively closed with tissue adhesives. Research has concluded that the newer adhesives are comparable to traditional monofilament suture material such as nylon. After allowing the product to solidify for approximately three minutes, a wound closed with the application of dermabond is as strong as tissue that has been approximated, sutured, and allowed to heal for one week (King & Kinney). Tissue adhesives essentially are maintenance free after the repair is complete. The glue sloughs off over time; no cleaning or ointment is needed and no follow up for removal necessary. A busy caregiver does not need to actively participate in the ultimate outcome of healing.

Review of Current Literature

Search Strategy:

Search engines used included CINAHL, PUBMED and the Cochrane Controlled Trials Registry. Key words included: octylcyanoacrylate, cyanoacrylate, skin closure and tissue adhesives; wound closure and tissue adhesives; traumatic laceration and tissue adhesives; laceration repair and outcomes. Articles chosen were published in the past seven years and included randomized controlled trials comparing tissue adhesives with standard wound closure. Key focus was placed on articles discussing cosmetic outcomes, infections and dehiscence rates,

expense and patient/provider satisfaction. Most articles selected focused on cosmetic outcomes as at least a portion of the overall study objective.

Synthesis:

Nineteen articles were reviewed; of these studies eleven were pertinent to the issue. The goal of this paper is to determine if the current research supports using tissue adhesives over traditional methods of suture for appropriate lacerations. See table for comparison of articles reviewed for this paper.

Article	Design and Sample	Results
Randomized Controlled Comparison(Zempsky, 2004)	RCT prospective 100 subjects(1-18 years old)	Procedural pain assessed using visual analog scale comparing steristrips and TA (p=ns) cosmesis (p=0.12) favoring TA
Cost-Consequence Analysis Comparing 2-Octyl Cyanoacrylate Tissue Adhesive and Suture for Closure of Simple Lacerations:A Randomized Controlled Trial(Hollander, 2004)	RCT of 186 patients(over the age of 18)	TA initially higher cost healthcare more 27 vs 21.96 but a lower charge to patients \$14 vs \$20.12 than the conventional suture method. The mean CVAS, WES, of the 2 groups were similar at various intervals. TA had a shorter median procedure time, and there was a higher overall patient satisfaction score.
TA for traumatic lacerations: A Systematic review of RCT(Farion,2003)	Lit Review:546 articles; 22 found relevant; reduced to 13	To summarize best available evidence on the effects TA.strongpainless(C confidence interval95%)/ no significant cosmetic difference/ all scores favored TAs/ time favored TAs
A Prospective Comparison of oycyl-2-cyanoacrylate and suture in standardized facial wounds (HandscheI,2005)	RCT prospective 45 adults	Lower eyelid in adults no cosmetic differences; wounds not standardized; TA performs as well as suture in terms of early complications such as infection and dehiscence
Cosmetic Outcomes of Facial Lacerations Repaired With Tissue-Adhesive, Absorbable, and Nonabsorbable Sutures(Holger,2004)	RCT prospective 150 ED patients age >5years old	Compare TA/Monofilament and gut in facial laceration repairs only. No significant difference at 9 and 12 months
Comparison of tissue adhesive and suturing in the repair of lacerations in the emergency department(Karcioglu, 2004)	RCT 92 adults	Limitations when used for nonlinear wounds/ good cosmetic appearance/when used appropriately with linear low tension wounds there is no advantage to use traditional suture methods
Sutured wounds: Factors associated with patient-rated cosmetic scores(Lowe,2006)	RCT prospective 132 patients	Found no relationship between experience level and cosmetic outcome with TA
Economic comparison of methods of	Lit Review 26 articles	Cost product plus labor(TA 28.11 suture

wound closure: wound closure strips vs.sutures and wound adhesives(Zempsky,2004)		24.77)based on initial cost suture is cheaper/ considering removal cost and equipment, adhesives is far cheaper
A review of the Literature on octylcyanoacrylate tissue adhesive(Singer, 2004)	Lit Review 24 articles, included 13 animal studies	quick application(1 to 6 minutes); infection 1.1% with TA(0.7% with standard) this was rebutted with animal studies reviewed; cosmesis CVAS used no significant difference at 12 months
Patterns of use of topical skin adhesives in the emergency department (Singer, 2009)	chart review(755 charts)	>4% presenting to ED had lacerations and over 50% were <2cm linear(85%) low tension wounds; 10 day healing rates excellent healing rates < 3% infection rate; limitations: high tension wounds
Tissue adhesives for traumatic lacerations in children and adults (Review)(Farion,2009)	Lit Review 13 articles	Eleven studies compared a tissue adhesive with standard wound closure, two compared types of adhesives. No significant difference was found for cosmesis at any time point examined, using either CVAS or Wound Evaluation Score(WES). Pain scores and procedure time significantly favored tissue adhesives.

The following discusses the findings of each of the main components, which are cosmesis, risk of infection, expense and procedural pain.

Cosmesis:

Cosmesis was found to be a primary outcome reported by all selected studies. In both Cochrane review articles led by Farion (2003 and 2009), and the studies of Hollander (2004) and Singer (2004), it was apparent that researchers use the Cosmetic Visual Analogue Scale (CVAS). The CVAS is a 100 mm line, with zero being “worst scar imaginable” and 100 being the “best scar imaginable”. A blinded evaluator, usually a plastic surgeon, rates the appearance of each laceration, either in person or from a standardized photograph, by placing a mark along the line (Farion et al., 2009). This is a standardized tool developed to assess laceration repairs in clinical trials. It has been validated, making objective data much more reliable (Holger et al., 2004). Singer, et al(2003) states that, minimally clinical important difference (MCID) is ensured when the difference in CVAS scores range less than 10 mm to 15 mm between two evaluators. This

was supported by Holger et al. (2004), “A score with a difference of 10-15 mm is considered significant.”

Farion, et al (2009) reviewed nine studies with 889 lacerations that compared tissue adhesives with standard wound closure using the CVAS outcome measure. Overall, there were no significant differences between tissue adhesives and standard wound closure at any of the time points examined. The median difference in CVAS scores for the 889 lacerations was 0.0 mm days 5 to 14; 1.6 mm at 3 months and 1.5 mm at 9 to 12 months (Farion et al., 2009). Holger et al., (2004) also looked at the repairs at specific time intervals; three, nine and twelve months post repair. When used with linear low tension lacerations there is no cosmetic difference between wounds closed with glue and those closed with monofilament. In Holger’s study patient perception of cosmesis was also included. CVAS score was assigned independent of the physician evaluator. It was found that the physician scores and the patients were very close, averaging 2.7 mm for physician and 3.6mm for patient, well within the 10 to 15mm set as a minimum clinically important difference (Singer & Thode, 2003).

“A small, but significant increased risk of dehiscence was found with tissue adhesives. The estimate of this risk difference is 2.4% (95% CI 0.1 to 4.9; Number Needed to Harm (NNH) 40, 95% CI 20 to 1168)” (Farlon et al., 2009, p. 9). Singer & Thode (2003) also found when comparing five RCT’s that the rate of dehiscence was 0.9 % compared to 0.3% for standard suture. There are numerous variables, type of wound, patient condition, and provider skill that could all factor into this. Also, it is not known whether dehisced wounds, including those that require secondary closure, have a different cosmetic outcome than those without dehiscence. This needs further retrospective research. However, again and again in each article reviewed, there were no discernable differences in the cosmetic outcomes between similar lacerations

repaired with traditional suture material versus those repaired with tissue adhesives. The key was choosing appropriate lacerations. Low tension linear lacerations, regardless of length or depth, were best closed with tissue adhesives.

Risk of infection:

Tissue adhesives have been found to decrease infection due to their bacteriostatic and bactericidal effects against gram positive microorganisms (Karcioglu, Goktas, Coskun, Karaduman, & Menderes, 2002). Both staphylococcal aureus and Streptococci are gram positive, live on the skin naturally, and are known to cause skin infections. There is an occlusive environment created when a tissue adhesive is used to close a wound. This acts as a microbial barrier. "The skin adhesives perform as well as the standard wound closure techniques in terms of early complications such as infection and wound dehiscence"(Handeschel et al., 2006, p. 321). Singer et al (2010) compared infection rates. 217 surgical patients were enrolled in a randomized trial. It was found in this group adhesives had three percent risk and suture had a seven percent infection rate at a ten day follow up ($p=0.11$) (Singer et al., 2010, p.672). Supporting data was found by Zempsky, Zehrer, Lyle, & Hedbloom, (2005). Their study found that infection rates for sutured wounds were twice as high as similar lacerations closed with tissue adhesives.

King & Kinney (1999) compared animal studies in which wounds were intentionally contaminated prior to closure with an adhesive. They did not become infected. Wounds closed with adhesive alone had lower counts than wounds containing suture material ($P < 0.05$) (King & Kinney). Another experiment was done testing the bactericidal properties of cyanoacrylate. Two tubes containing the same medium were prepared, one had four drops of cyanoacrylate added, and the other did not. Over the course of several days the tube without cyanoacrylate grew

significantly more bacteria (statistic significance was defined as <0.05 ; CI 95%) (King & Kinney, 1999).

Another factor to consider is the body's natural reaction to a foreign body; the foreign body being the sutures. Localized erythema was found more often in patients repaired with standard suture. Farlon et al. (2009), stated "The random effects estimate of this risk difference is 95% with Confidence Interval -19 to -0.4" It is difficult to determine the clinical significance of this finding without additional information. Redness in itself does not mean that a wound is infected; it does indicate that there is a reaction. The body reacts to the presence of the suture material used to close a laceration. This reaction may cause pain, irritation and further inflammation. All factors that will ultimately impair wound healing (Trott, 2005).

Expense:

Zempsky, Zehrer, Lyle, & Hedbloom (2005) looked at cost comparisons between repair methods. Initially, the cost per unit of a cyanoacrylate product is more than monofilament. The claim is that cost is based on the product price plus physicians labor. There was not a specific price cited in any of the articles for physician services. Application time is less than five minutes when adhesives are used. As stated previously, it takes approximately three minutes for cyanoacrylate to solidify (King & Kinney, 1999). Suturing times are harder to predict or generalize. "Literature estimates on average it takes 8.6 minutes to suture a simple laceration"(Zempsky et al., p. 274). This does not include the equipment set up time or recovery time when sedation is used. Singer & Thode (2003) claimed "Time to close skin with sutures was four times that of adhesive." At that time the average cost of one pack of tissue adhesive ranged from \$24 to \$28 and one pack of suture material cost between five and twenty four

dollars. When repairing a simple laceration with a tissue adhesive, additional equipment is unnecessary. Suturing involves sterile equipment which minimally includes the needle holder, iris scissors, forceps and sterile drapes (Trott, 2005). Karcioğlu et al. (2002) claimed that the cost of sutured laceration were twice the cost of those closed with tissue adhesive. “Absorbable sutures were found to be 2.4 times more costly than tissue adhesives, while non-absorbable sutures were 6.8 times more costly, due to the need for a repeat visit” (Farlon et al., 2009, p. 10). The Karcioğlu article discusses a study done by Osmond, et al. (1995) in which thirty pediatric patients were enrolled in a cost analysis study. They found the mean cost of suture \$49.60; the mean cost of tissue adhesive \$37.90.

The procedural time saved, reduction in length of stay, and eliminating the follow up to remove sutures would be a substantial savings for the patient and healthcare system. Complications such as infection, dehiscence and poor cosmetic outcome compound expense. “The average cost of antibiotics for infected wounds is \$47.” (Zempsky et al., p. 275). As stated previously infection rates are lower when a tissue adhesive is used. “The results suggest that adhesives are a cost-effective alternative to conventional suturing for selected lacerations for routine use in the ED.” (Karcioğlu, Goktas, Coskun, Karaduman, & Menderes, 2002, p.157) Overall the evidence suggests that using tissue adhesive is a cheaper method of laceration repair and results in greater satisfaction of both the patient and the practitioner.

Procedural Pain:

The goal of providers working with children is to offer a safe, pain free experience as much as possible. Farlon et al. (2009) found that all pain score results, either patient or parent reported, were significantly more favorable of tissue adhesives. Six studies in the review

measured pain scores using a visual analog scale (VAS) in which pain is rated 100mm line (0=no pain to 100=worst pain). In 570 cases where tissue adhesives were used, parents reported VAS averaged 13.4, patient reported was 10.8, physician reported 12.6 and nurse reported 14.9. All results were significant (defined as $p < 0.05$) and favored the tissue adhesive interventions.

Parents overall perceived that their children experienced less pain with adhesives. Anticipated pain is also a factor when dealing with children. The quicker a procedure can be completed removes that anxiety. "Time to close skin with sutures was four times that of adhesive and there were no incidence of wound dehiscence, hematoma or infections" (Singer & Thode, 2003, p. 242). Pediatric patients experience less pain, fear, and agitation with adhesives (Farlon, 2003). Avoiding painful and anxiety provoking experiences will ultimately help children and their parents cope better with future emergent situations; they are able to establish a trusting rapport with medical providers (King & Kinney, 1999). Traumatic stress related to childhood healthcare has great implications. Adolescents and adults are less likely to seek necessary healthcare services if childhood care was viewed negatively.

Another anticipated benefit of using tissue adhesives is the elimination of pain and anxiety related to suture removal. The stress and anxiety caused by the initial injury was often unavoidable; the repeated trauma or fear of suture removal could be avoided. Research shown trends, which indicate that low tension, linear wounds will have the same favorable cosmetic outcome regardless if closed with suture or adhesives. The deciding factor should then be the least traumatic to the patient.

Discussion:

Examination of the research studies found regarding the use of tissue adhesives versus suture resulted in comparing four major components: cosmesis, risk of infection, expense and procedural pain. Based on comparisons, an evidenced based decision can be made. There is now a large body of research demonstrating the efficacy and safety of tissue adhesives in a wide range of ages and body locations. There is absolute evidence that low tension linear lacerations benefit by the use of octylcyanoacrylate (Singer et al., 2010).

Research supports that lacerations repaired with tissue adhesives are cosmetically equivalent to traditional sutures. Adhesives do not increase complications for wound healing. In fact, adhesives form a protective barrier to promote healing and have antimicrobial effects. Effective application is a quickly learned skill compared to suturing. Adhesives can be applied more quickly, have equal strength and flexibility, and require no anesthesia. Although adhesives cost more per unit than sutures, they are more cost effective. Cost benefits of adhesives include quick application, no extra equipment needed, and no follow up expense. Overall the evidence suggests that using a tissue adhesive is a cheaper method of laceration repair and results in greater satisfaction for both the patient and the practitioner.

Implication for Counseling and Education

Based on the research consensus, there are implications for counseling. Counseling is defined by Mosby as “the act of providing advice and guidance to a patient or the patient's family.” Parents trust the healthcare provider to do what is their child’s best interest. Jean Watson, a well known nurse theorist, developed the Theory of Caring. Her theory provides the framework to discuss the option of tissue adhesives for patients and their families. Given the choice, most parents would prefer not to have to put their child through the trauma of sutures and

suture removal if another option provided equivalent results. “A caring environment is one that offers the development of potential while allowing the person to choose the best action for him or herself at a given point in time.”(Current Nursing, 2009, p. 1) When managing the care of a patient with a simple linear laceration there are options.

This leads to implications for educational needs for healthcare professionals regarding tissue adhesives. As discussed earlier in this paper an informal survey of providers at a busy urban emergency room, which manages thousands of laceration repairs a year, revealed that although knowledgeable of the use and benefits, most choose to suture when the use of a tissue adhesive would have been an equal or better option (Staff Childrens ED & Staff Stillwater Medical Clinic, personal communication, Winter, 2011). Many primary care providers throughout the metropolitan area recommend Children’s Hospital emergency departments when their pediatric patients have lacerations in need of repair.

The onus is on us to provide current evidence based care. A compelling presentation on the benefits of tissue adhesives should be given at a professional staff meeting. At this time training could be provided. The hospital policy regarding skin closures should be reviewed and a system change proposed. The expectation should be that tissue adhesives will be the standard of care with lacerations repairs that are linear, low tension, traumatic lacerations in our pediatric emergency department. As a result there will be a ripple effect into the area clinics and the use of tissue adhesives will become common.

Role of the APN/Implications for practice

According to Watson, the scientific problem solving method is the only method that allows for control and prediction (Current Nursing, 2001). Watson also values the relative nature

of nursing and supports the need to examine and develop the other methods of knowing to provide holistic care. According to Barbara Carper, there are four patterns of knowing in the profession of nursing. These include esthetic, personal, ethic and empiric knowing (White, 1995). Esthetic knowing is the art of nursing, the ability of the nurse to intuitively know what the patient needs. Experience teaches a nurse to trust esthetic knowing; follow their instincts. It is the individualization of care, which is fluid. Instinct may direct the APN to use sutures for a child when the parents view the use of adhesives as substandard care, causing more stress to the family than the actual procedure. Personal knowing involves the willingness to be present and connected with a patient. It is seeing the patient as a person. "Understanding his world as if I were inside it" (White, 2009, p. 426) When our patients and families become real people and not just the illness or injury, we are using personal knowing.

Ethical knowledge is referred to as the moral component; making choices that ought to be made. (White, 2009) Ethical knowing is based on the promise to serve and respect life. This knowing requires the nurse to spend time listening and reflecting on what a patient needs and then empowering them to make the best choice. Nurses base practice on the principles of nonmaleficence, beneficence, autonomy, veracity, confidentiality, fidelity and justice (Pharris, 2009). The concept of nonmaleficence is the easiest for healthcare workers to intellectualize. We vow, first and above all else, to do no harm. Providers, choosing to continue suturing, when evidence supports use of tissue adhesives as best practice, is harmful.

Finally, empirical knowing is the science of nursing, which is based on facts, consistent reliable information. The randomized control trials and compiled research results have provided this knowing. As advanced practice nurses we are in a fortunate position to help move the evidence based practice of wound repair from the journals to the patient. This could be viewed as

an opportunity to conduct an additional study, with a large sample size to solidify the previous research conclusions. This would assist in the “buy in” lacking in the healthcare community. Tissue adhesive should be considered for the closure of all linear low tension lacerations. This would improve family satisfaction; reduce expense and time that could be used to serve the needs of other patients.

Conclusion

Evidence shows that the benefits support the recommendation that for most children, low tension linear lacerations should be closed with a tissue adhesive. It has been shown through research that this choice provides cost savings, time efficiency, decreased infection rates and equitable cosmesis when compared to suturing. The child experiences less pain and anxiety, which eliminates the need for sedation. Parents are more satisfied with the care received and may be more willing to seek help for their child when future needs arise. As Pediatric Nurse Practitioners we will encounter many children in need of simple laceration repair. Applying evidence based practice in our decision making will only prove to benefit our patients.

Internet Resources (list URL and brief critique)

URL	Intended Audience	Summary
http://kidshealth.org/	Parents, Teens and Children	This is an excellent website with separate links for parents, teens and young child. Parents are given practical advice in dealing with small to large cuts. Included is when to seek medical care. The kids page uses age appropriate language to explain what will happen if stitches are needed. Tissue adhesives are briefly mentioned but no recommendation is made.

http://www.dermabond.com/applications/caring-wound.html	Patient, Parents and Providers	<ol style="list-style-type: none"> 1. Great patient education on the care after dermabond application. Lists specific do and don't to ensure optimal product performance. Example: "Do not scratch, rub, or pick at the wound or DERMABOND®; doing so may loosen the film before the wound is fully healed" 2. Has a demonstration video for providers with a disclaimer that only healthcare providers should apply product. 3. Marketing and informative
http://childrensmid.org/brochure-by-age-group/newborn-infants/skin-glue-or-stitches/	Parents	Factual advice on when tissue adhesives are appropriate and which wounds should be repaired with sutures. The article also educates on what to expect for pain control if suturing is necessary. This is a very informative patient education article.
http://www.aafp.org/afp/20000301/contents.html "Using Tissue Adhesives for Wound Repair"	Providers	<ol style="list-style-type: none"> 1. List advantages of using adhesives 2. Lists contraindications such as jagged wounds over high tension areas. 3. Gives step by step application directions

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