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Review

## **Knee Arthroplasty Wound Closure With Absorbable Subcuticular Staples: A Retrospective Review Of 104 Consecutive Procedures**

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### **Abstract**

#### Background

The selection of skin closure modality for knee arthroplasty is an important decision that can affect the risk of wound complications, operating room efficiency, patient satisfaction and the economic outcomes of the procedure. Absorbable subcuticular staples are a new closure modality reported to be as fast as percutaneous metal staples with the comfort and cosmesis of subcuticular suture and no staple removal. A study in the orthopedic literature that compared absorbable staples to metal staples in total hip arthroplasty demonstrated less wound discomfort, drainage, erythematous reaction, and higher patient satisfaction with absorbable staples. Absorbable staple use in knee arthroplasty has not been reported in the clinical literature. The objective of this study is to evaluate the experience and outcomes of wound closure with subcuticular absorbable staples in knee arthroplasty.

#### Method & Results

During a one year period 104 consecutive patients received absorbable staples in 101 elective primary total knee arthroplasties and 3 unicompartmental arthroplasties and were followed at 2, 6, and 12 weeks. Procedures and exams were conducted by the authors. Closure times of approximately 2 minutes were 5-7 minutes faster than with suture. Inflammation and erythematous reactions were notably minimal or absent at follow up. There were no infections. Patients described their wounds as comfortable and satisfying in appearance. Two postoperative hematomas were associated with wound separation; a 1cm gap was closed with an adhesive strip and the other required debridement and irrigation.

#### Conclusion

Absorbable subcuticular staples are a safe, secure, efficient, and effective modality for skin closure in knee arthroplasty. Compared to our experience with suture and metal staples the key advantages of absorbable staples are time savings in surgery and the clinic, uncomplicated cosmetic healing, and improved patient satisfaction.

## Introduction

The skin closure modality of choice in total knee arthroplasty (TKA) should provide rapid secure closure with the least possible complications, comfortable unimpeded healing, cosmetic appearance, and a high level of patient satisfaction. Wound complications can interrupt patient recovery, increase costs and hospital stays, and add to patient morbidity. Our earlier choices of skin closure modalities have been the fast percutaneous metal skin staples and then more recently we selected absorbable subcuticular suture as a more tolerable closure for our patients because of comfort, cosmesis, and elimination of staple removal. Despite those advantages, suturing is slow and tedious, and a faster closure modality would be desirable to improve efficiency and patient safety with shorter operating and anesthesia times.

We were intrigued by the subcuticular absorbable staple (INSORB<sup>®</sup>, Incisive Surgical, Inc., Plymouth, MN) (Figures 1,2) as a promising alternative to sutures and metal staples. It's a fast closure modality like metal staples without the need for staple removal, and potentially providing the comfort and cosmesis of an absorbable subcuticular suture. The novel modality of subcuticular absorbable staples includes unique features that may support uncomplicated healing and greater patient satisfaction with comfortable wounds and cosmetic scars. These favorable outcomes with absorbable staples have been demonstrated in clinical studies in a wide range of surgical specialties with the predominant experiences being in cosmetic surgery and obstetrics [1-6]. The reported orthopedic experience is limited to a prospective randomized study by David Fisher, et al. [7] that compared total hip wound closures with either metal skin staples or the subcuticular absorbable staples in 60 patients randomized by closure modality. The authors concluded that "Wound comfort was reportedly better at all times with the resorbable staples ( $p < .01$ ) compared with the metal staples. The absorbable staple system used in this study provided satisfactory wound closure comparable to metal staple closure after total hip arthroplasty. Additional benefits included less erythema and wound drainage at 2 weeks and improved patient comfort with no need for staple removal in the absorbable staple group."

To our knowledge there are no previous reports of experience with the subcuticular staple in TKA. The objective of this study is to evaluate the experience and outcomes of wound closure with subcuticular absorbable staples in knee arthroplasty.

### Figure 1

INSORB Subcuticular Skin Stapler. The stapler contains 30 absorbable staples, sufficient to close a 21 cm incision. The wound closure is a simple and rapid single-operator technique that places subcuticular absorbable staples horizontally within the dermis at approximately 7mm intervals.



## Figure 2

INSORB Absorbable Staples. The absorbable subcuticular staple consists of a co-polymer of approximately 70% polylactide and 30% polyglycolide that breaks down by hydrolysis with substantial absorption in 10-12 weeks and with minimal inflammatory response.



## Materials and Methods

During the one year period beginning June of 2013 the subcuticular absorbable staple was used to close the skin in a total of 104 consecutive elective primary knee arthroplasties composed of 101 total knee (TKA) and 3 partial knee procedures. Exclusion criteria included knee arthroplasty revisions, any sign of infection, and patients with skin too thin for secure staple placement. In this patient series four elderly female patients presented with skin judged to be too thin.

Our wound closures begin following tourniquet deflation and then meticulous exploration and hemostasis that are completed in about 5 minutes. The proximal portion of the arthrotomy is closed to a midpoint with the knee at 15° flexion using a 1-0 Vicryl™ (Ethicon, Johnson & Johnson) continuous suture. The knee is then placed at 90° flexion and the distal portion is closed with 7 to 10 simple interrupted stitches of 1.0 Vicryl. The deep adipose layer is closed with an interrupted 0 Vicryl suture. The superficial subcutaneous layer is then closed with 2-0 Monocryl™ (Ethicon, Johnson & Johnson) interrupted absorbable stitches placed at about 2cm intervals and approximately 1 cm from the wound edges. With these stitches the wound tension should be sufficiently relieved to closely approximate the wound edges. The suture placement at 1 cm from the wound edges is required to allow introduction of the stapler nose into the incision where it interfaces with the subcuticular dermal tissue for staple placement. Staples are placed by grasping 5 mm of both wound edges at an apex or above a previously placed staple with a single Adson toothed forceps and lifted upward to be mated with the stapler nose while the stapler is fired. The staples are placed horizontally within the dermis at approximately 7 mm intervals forming wound eversion that is sustained during a period of initial healing 10 to 14 days post-operative (Figure 3). The sterile single use stapler contains 30 staples, sufficient to close a 21 cm incision. The 3x5mm staples are comprised of a polylactide-polyglycolide co-polymer that breaks down by hydrolysis with substantial absorption in 10-12 weeks and demonstrate a minimal inflammatory response that is less than what is typically seen from suture or metal staples [8]. The stapler is a safety engineered device that meets OSHA (Occupational Safety and Health Administration) requirements to reduce the risk of suture needlestick injuries.

Drains were placed in about 40% of patients when there was evidence at surgery to suggest that excess drainage might be anticipated. Drains were removed on the first postoperative day.

Adhesive strips for wound protection were applied across the incision without tension or tenting. Wounds were typically dressed with a non-adhering dressing, gauze, ABD pads, and an elastic wrap left in place for 2 days. Wounds at one facility were dressed with Aquacel<sup>®</sup> AG (Convatec) silver containing antimicrobial dressing that can be kept in place for 5-7 days.

Enteric coated aspirin was prescribed post-operatively at 325 mg twice daily for 30 days as a prophylaxis for deep venous thrombosis (DVT). Aspirin after TKA has been reported to be a safe and effective alternative to other blood thinning drugs that require more demanding management and present greater bleeding risk [9, 10]. Aspirin as a DVT prophylaxis specific to TKA is addressed in the “American College of Chest Physicians evidence-based clinical practice guidelines” [11]. Accordingly, patients with a history DVT, a coagulopathy, or any suspected predisposition besides the present surgery are treated immediately with enoxaparin low molecular weight heparin and then transitioned to warfarin and continued for a minimum of 30 days. Patient follow-up visits were conducted at 2 weeks, 6 weeks, and 3 months. All procedures and follow-up exams were conducted by the authors.

### Figure 3

The closure at surgery. This absorbable staple closure at surgery demonstrates the uniform and pronounced eversion with well approximated wound edges. The intradermal staples are inserted horizontally at 7mm intervals and at a depth of 5-8mm from the wound edges.



## RESULTS

There were 104 consecutive elective knee arthroplasty procedures in three community hospital settings during a one-year period from June 2013.

Wound closure with the INSORB Stapler is a simple and rapid single-operator technique that takes about 2 minutes or less to close a 10-14cm knee incision, saving 5-7 minutes compared to suture closure. Subcuticular staples create a secure uniform closure with prominent eversion of the well approximated wound edges (Figure 3). Inflammation and erythematous reactions were notably minimal or absent at follow up. There were no wound infections in this series. Two wound separations that occurred were each associated with a hematoma. One separation was a 1cm gap closed with an adhesive strip after the hematoma was expelled, and the other was a larger separation closed with suture following wound evacuation. Both healed uneventfully. Total blood loss was approximately 30-50 ml at surgery and 100-200 ml post-operatively when a drain had been placed. There was a welcome elimination of the uncomfortable and bothersome shear blisters we have previously seen with adhesive strips applied to closures with continuous suture. We postulate that this absence of blistering is a result of the sustained wound eversion that accommodates swelling and stresses to prevent skin shear attributed to tension on the adhesive strips.

The absorbable staple wound closures were typically uncomplicated and low maintenance without the inconvenience, expense, or discomfort of metal staple removal. Patients described their incisions as comfortable and satisfying in appearance (Figure 4,5).

### Figure 4

Subcuticular staple closure at 2 weeks. This closure modality appears to be minimally traumatic. These were low maintenance wounds with very little apparent inflammation. Patients reported their incisions closed with absorbable staples were comfortable and pleasing in appearance.



## Figure 5

Subcuticular staple closure at 6 weeks. The closures at follow-up appear to have healed well with thin flat scars and the eversion has subsided.



## DISCUSSION

The clinician faced with the selection of a conventional skin closure modality must compromise and accept the limitations of either suture or metal skin staples. The absorbable subcuticular skin stapler provides the comfort and cosmesis of absorbable subcuticular sutures with the speed of a metal skin stapler [1-7].

A knee skin closure with the INSORB stapler is an easy single-operator technique that takes about 2 minutes and saves 5-7 minutes of operating time compared to suturing, contributing to patient safety and cost saving efficiency. The stapler places subcuticular absorbable staples horizontally within the dermis about 5mm from the wound edge at approximately 7mm intervals to create a securely approximated and everted closure (Figure 3.). The staples achieve a uniform symmetrical approximation of the dermis to form a pronounced wound eversion that effectively diverts tension from the wound edges during healing. Wound eversion is a feature of cosmetic surgery to achieve optimal healing and yield a thin flat cosmetic scar. Clinical studies of the subcuticular staple in cosmetic and reconstructive surgery have demonstrated rapid wound closure with unimpeded healing and cosmetic outcomes equivalent to suture (5,6). The subcuticular staple modality has been shown to be minimally traumatic without the percutaneous injury and tissue compression of metal staples, or the tissue strangulation from suture, all of which can compromise tissue viability and precipitate complications, e.g., delayed healing, wound necrosis, separations, infection, and discomfort [2,4,8,12,13].

The subcuticular staples are interrupted fasteners that do not form a water-tight closure and allow natural physiologic drainage that can reduce the risk of seroma and infection. The interrupted staples also eliminate the risk of suture line infections attributed to continuous subcuticular suture. Studies of contaminated wounds closed with absorbable subcuticular staples have shown a significantly lower risk of infection compared to continuous absorbable suture or percutaneous metal skin staples. [8, 12,13]. Wound intervention, when needed, can be selectively limited by cutting the backspan of individual staples with a heavy scissors and leave the remnants in place without consequence.

Images of these closures at follow-up intervals demonstrate wounds that heal well with thin flat scars (Figures 4,5).

## **CONCLUSION**

Absorbable subcuticular staples are a secure, efficient, and effective modality for skin closure in knee arthroplasty. Compared to our experience with suture and metal staples the key advantages of absorbable staples are time savings in surgery and the clinic, uncomplicated cosmetic healing, and improved patient satisfaction.

The study has the intrinsic limitations of a retrospective review, although having a single setting and surgeon eliminates many confounding variables for evaluation of the test materials. A prospective randomized study of absorbable staples and other modalities could provide significant qualitative measures for comparisons.

## **Abbreviations used:**

(TKA) Total knee arthroplasty; (DVT) Deep Venous Thrombosis; (OSHA) Occupational Safety and Health Administration.

## **Disclosures**

### Competing Interests

Dr. Biebl and Nate Nistler have nothing to disclose.

### Author's Contribution

JB and NN contributed the study concept, carried out the surgical procedures and study, and contributed to preparation and review of the manuscript. The author read and approved the final manuscript.

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JB is a practicing orthopaedic surgeon and NN is a practicing physician assistant at Summit Orthopedics.

## **Clinical Trials**

The IRB waived review of this qualified retrospective study.

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