

# Dermabond Significantly Increases Tensile Strength of Common Surgical Sutures

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**INTRODUCTION:** Wound closure failure is due to a combination of mechanical and biological factors<sup>1</sup>. Improper closure and apposition of tissue edges is associated with delayed healing, dehiscence, and acute complications such as infection or necrosis, resulting in suboptimal tissue restitution and cosmetic appearance<sup>2,3</sup>. The risk for these complications can be reduced by considering the wound’s location, size and depth, and effective tensile forces in order to choose the most suitable method and materials used for closure<sup>4</sup>. Due to the high tension experienced on joints as load-bearing points, they are vulnerable to wound healing complications such as infection, which can pose a threat to metal implants and hardware<sup>5</sup>. Maximizing wound closure strength in such areas of higher tension is critical to successfully coapting the wound edges and preventing complications. Dermabond is an adhesive glue frequently used as an occlusive dressing because of its many protective qualities such as being strong, antimicrobial, flexible, and waterproof<sup>6,7</sup>. While some studies have previously compared outcomes, efficacy, and cost-effectiveness of the use of Dermabond alone versus sutures or staples alone, they did not quantify the actual contribution of adhesives to suture strength when the two are used in combination. The purpose of this study was to evaluate how this glue might enhance the tensile strength of the suture materials typically used for wound closure in orthopedic surgery. We hypothesized that the direct application of Dermabond to suture knots would enhance their strength.

**METHODS:** Five commonly used sutures were selected: Silk, Monocryl, Vicryl, Prolene, and Nylon, all 3-0. Loops of 94.2mm were tied with a base knot of a surgeon’s knot followed by four regular knots for reinforcement. Dermabond was applied to the sutures via a small drop on the knot itself. Tensile testing was performed using an Instron E3000 Fatigue System (Instron, Norwood, MA) equipped with two hooks to apply a tensile load to the constructs at a displacement rate of 5 mm/min while recording load displacement data at a rate of 1000Hz. There were 8 repetitions performed for each group for a total of 80 experiments. Strength was evaluated as the peak load prior to failure. Dermabond influence was tested using paired T-test or the equivalent non parametric Wilcoxon signed-rank test comparing to the control knots without Dermabond. All the analyses were performed in R with a level of significance of 0.05<sup>8</sup>.

**RESULTS SECTION:** All sutures were stretched until failure at a rate of 5mm/min by breaking at the knot. For the constructs without Dermabond, the lowest peak load of 31.6N±0.7 was recorded for Silk, while the highest peak load of 46.3N±3.7 was recorded for Monocryl. The highest increment of 44.4% (p<0.01) was recorded for Vicryl which showed a peak load of 63.1N±3.0 with Dermabond up from 43.70N±4.49 without Dermabond. This peak load of 63.1N±3.0 for Vicryl with Dermabond also represented the highest peak load measured among all constructs both with and without Dermabond. The lowest increment of 2.8% (p>0.05) was recorded for Silk with a peak load of 31.6N±0.7 without Dermabond and a peak load of 32.5N±1.3 with Dermabond.

**DISCUSSION:** In our study, we found that the direct application of Dermabond onto suture knots increased the tensile strength of Monocryl, Vicryl, Prolene, and Nylon. Vicryl had the greatest percentage increase in strength, up 44.4% with the addition of Dermabond. While we only selected five suture types in our study, they were selected for their common use in surgery, specifically skin closures, and for their varied properties of being both non-absorbable and absorbable and both monofilament and braided. Our study also did not simulate the in vivo wound healing environment, but other studies have done tensile strength testing outside of tissue models. We were also limited by the number of throws but in another study, they found higher forces when increasing from three to seven throws<sup>9</sup>; thus, we would expect our measured construct strength to increase with a higher number of throws. While only 3-0 sutures were tested in our study, we would expect to find higher tensile strength in larger-diameter sutures since greater tensile strength is known to be positively correlated with diameter<sup>10</sup>. This size suture was specifically chosen for its use in tendon repair in orthopedics and, more broadly, in closure of areas of the skin subject to tension<sup>11,12</sup>. Dermabond is a cyanoacrylate commonly used by itself, but we found that when added directly to Monocryl, Vicryl, Prolene, and Nylon suture knots, they are strengthened. These findings suggest that use of the two in combination can be beneficial in skin closures at areas of high tension. These results could be applied to other fields such as the abdomen, which experiences high tension due to increased intraabdominal pressure when coughing or straining<sup>13,14</sup>.

**SIGNIFICANCE/CLINICAL RELEVANCE:** For cases in which there is a need for stronger closures, such as joints, Dermabond can be considered a viable enhancement for Monocryl, Vicryl, Prolene, and Nylon. For those four, those advantages persisted through 7 days following application of Dermabond to the suture knots. This knowledge of an adaptive increase in tensile strength can be translated to increasing the strength of wound closure and in preventing complications such as dehiscence, infection, and poor cosmetic outcomes.

**IMAGES AND TABLES:**

