Value Analysis Brief—ORTHOCORD® High Strength Orthopedic Suture

Introduction

This value analysis brief presents information on the potential clinical, economic, and humanistic (patient) benefits of using the ORTHOCORD® suture in orthopedic surgery procedures. This partially absorbable suture is made of a unique combination of polyethylene and polydioxanone and is applicable where high mechanical strength is required. The referenced data were obtained through a search of MEDLINE for clinical and mechanical studies for first- and second-generation sutures. Conference proceedings and internal documents (i.e., white papers) also were included in this analysis due to limited published data for this technology.

Note: ORTHOCORD suture and its material composition are unique to DePuy Mitek. Thus all studies referenced herein pertain directly to this suture technology.

Background

Achieving optimal clinical and functional outcomes after surgery depends on a variety of factors. Perhaps foremost is expert surgical technique but even seemingly minor details such as surgical supplies may contribute to long-term clinical success. There is an increased understanding of the importance of suture material in arthroscopic procedures involving soft tissue repair and healing. Newer suture materials have been designed with this in mind. The new trends in suture composition are now based on ultrahigh molecular weight polyethylene with or without a longitudinal core of other material. DePuy Mitek’s ORTHOCORD suture is unique in that it is partially absorbable due to its polydioxanone (PDS) core. The composition of #2 ORTHOCORD suture is 62% PDS and 38% ultra high molecular weight polyethylene. In addition, it has been engineered to balance strength, abrasion, cut resistance, and flexibility. All of these features create a suture that is optimized for today’s arthroscopic and soft tissue procedures.

ORTHOCORD suture addresses the needs of today’s arthroscopic and soft tissue procedures due to its:

- High tensile and knot strength (mechanical properties),
- Balance of knot slide ability, knot security, stiffness, and elastic tension (handling properties),
- Less likelihood of abrasion to surgical anchors, surrounding tissues, or surgeon’s hand,
- Small knot profile, and
- Ability to promote less bacterial adherence

These design elements and material characteristics translate into a number of potential benefits to various stakeholders.

ORTHOCORD Value Propositions

ORTHOCORD sutures provide high tensile and knot strength for intra-operative tendon to bone fixation and maintain this strength during the post-operative period.

Strength is a hallmark feature of suture material. In both in vivo and in vitro testing, the tensile and knot strength of ORTHOCORD suture has been demonstrated to be equivalent to other second generation sutures and superior to polyester/monofilament sutures.

For example, a recent study by Wust and colleagues comparing the mechanical and handling properties of different sutures found that the tensile strength of polyblend suture material (i.e., ORTHOCORD suture) was 2- to 2.5-fold greater than that of polyester sutures (i.e., Ethibond®).

Additionally, in vivo animal studies have shown that this initial tensile strength (50 – 55 lbs) is durable as well—92% of baseline tensile strength is retained (BSR) through 12 weeks (Figure 2) and 90% of baseline at 18 weeks.
The knot strength of ORTHOCORD suture (about 30 lbs) also has been demonstrated to be equivalent or better than other second generation sutures and superior to polyester/monofilament sutures based on in vitro competitive testing (Figure 3).  

Additionally, this strength is durable as well—85% of baseline knot strength is retained through 12 weeks.  

Wust and colleagues also examined suture elongation under peak load and found that ORTHOCORD suture had the highest elongation at failure of the new polyblend sutures and was therefore particularly apt to provide a snug adaptation.  

Overall, the tensile and knot strength of ORTHOCORD suture has been demonstrated to be equivalent to other second generation sutures, superior to polyester/monofilament sutures, and strong enough for soft tissue approximation or ligation.  

ORTHOCORD suture offers a balance of knot maneuverability, knot security, and elastic tension and provides excellent handling and flexibility for the surgeon.  

New suture materials and designs are constantly being introduced into the surgical marketplace. The choice of suture material is a surgeon-dependent variable that is often taken for granted. In addition to the mechanical properties of sutures such as tensile or knot strength, the handling properties of the suture from the surgeon’s perspective must also be taken into consideration.  

The study by Wust and colleagues also subjectively assessed the handling qualities of several types of sutures (Figure 4).  

The authors found that ORTHOCORD suture performed better than Fiberwire® and Ultrabraid® in the summary of all handling qualities, including knot slide ability, elastic tension, and handling ability.  

As a result of its higher elasticity, ORTHOCORD suture offers subjectively more elastic tension for knotting than Fiberwire®, Herculine®, or Ultrabraid®.  

Overall, the authors found that ORTHOCORD had better handling qualities than other types of sutures.  

Surgeons require a balance of strength and other handling characteristics in their suture materials. An overly stiff suture with increased strength properties may result in the suture cutting through tissue, absorbable anchors, or potentially the surgeon’s hand.  

For example, a stiffer material may actually cut through tissue while gathering slack as opposed to less stiff material. This may have clinical implications in that the younger tissue may be more suitable to a stiffer material and perhaps more frail tissue would be more suited to a less stiff material to “take up the slack” rather than cut through the tissue.  

A recent study by Jhamb and colleagues examined the properties of high strength suture materials including suture stiffness. The study results indicated that ORTHOCORD had the lowest initial suture stiffness and Ultrabraid® the highest stiffness (Figure 5).  

The mechanical and handling properties associated with ORTHOCORD suture may decrease the likelihood of abrasion to surgical anchors, the surgeon’s hand, or surrounding tissues.
ORTHOCORD also has shown to be less abrasive on surgical anchors compared to other sutures on the market.²⁴ The study by Wust and colleagues concluded that ORTHOCORD suture had the least abrasive and cutting effect on the absorbable Spiralok 5.0 anchor and Panalok 3.5 anchor.²

ORTHOCORD showed better results in the general handling characteristics when compared to similar sutures included in the Wust study. Due to ORTHOCORD’s higher elasticity, it tended to lend itself to more elastic tensioning for knot tying. Prior to this study, there was a subjective impression of greater injuries to the surgeon’s fingers associated with cutting of polyblend sutures because of the ability to tie stronger knots. However, the study by Wust and colleagues showed that there was no significant increase in injury occurrence.²

Similarly, when comparing abrasion to the surrounding tissues among the polyblend sutures (i.e., ORTHOCORD vs Fiberwire®), there is a subjective impression that the less stiff suture (i.e., ORTHOCORD suture) may lead to less abrasion to the surrounding tissue. These hypotheses will need to be confirmed in future studies.

The small knot profile associated with ORTHOCORD suture may result in less soft-tissue interference during the post-operative healing period.

ORTHOCORD has been demonstrated to have a smaller knot profile than those tied with other high-strength suture material. For example, a recent study by Ilahi and colleagues examining the security of knots tied with ORTHOCORD suture, Fiberwire®, Ultrabraid®, and Ethibond® found that openly tied 5-throw square knots were bulkier (greater knot height) for Fiberwire® and Ultrabraid® than those tied with either ORTHOCORD suture or Ethibond®.⁵

Additionally, because the majority of the ORTHOCORD braid is composed of absorbable PDS, the knot profile continues to diminish for several months after surgery, which may result in less soft tissue interference post-healing.⁷ ORTHOCORD’s small knot profile may result in a lower incidence of crepitus (described as a crackling, grinding, or crunching sensation in the joint).⁷

The monofilament polydioxanone (PDS) core of ORTHOCORD suture helps promote significantly less bacterial adherence. In addition to suture properties such as strength, knot security, handling, and failure mechanisms, bacterial adherence should be among the characteristics considered by surgeons when choosing a suture implant. This is especially true in patients prone to infection or in body areas at greater risk of contamination.⁶

A recent study by Masini and colleagues sought to investigate the difference in the infectious potential of high-tensile strength suture materials by quantifying bacterial adherence in an in vitro model.⁶ The suture types selected included ORTHOCORD suture, Maxbraid®, Fiberwire®, Ethibond®, and silk. The mean bacterial photon counts for each material are shown in Figure 6.

ORTHOCORD suture had the lowest mean bacterial count among the high-tensile sutures (i.e., Maxbraid® and Fiberwire®).⁶ A composite photo of the luminescent bacteria is shown in Figure 7.

Figure 7 indicates that ORTHOCORD suture (D) is significantly less bacterially adherent than the high-tensile sutures of Maxbraid® (A) and Fiberwire® (B).⁶
Although all of the high-tensile strength sutures have a non-braided long-chain polyethylene as a key structural component, they have widely different degrees of bacterial adherence. This is likely because of the different materials that complete the design of these sutures. ORTHOCORD suture has a monofilament polydioxanone (PDS) core that may not contribute significantly to adherence of bacteria, thus yielding lower counts. The polyester coating or braided jackets of the other sutures likely contributes to greater bacterial adherence.  

Reducing the risk of bacterial adherence during the surgical procedure may translate to cost savings.

Conclusions

Overall, the ORTHOCORD suture provides a supple solution for soft tissue repair, maintaining the strength and security desired in orthopedic sutures while minimizing postoperative knot mass. These design elements and material characteristics translate into a number of potential clinical, economic, and humanistic benefits.

Citations

1. Data on File at DePuy Mitek.
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