Technical Review:
A Next Generation Hybrid Meniscal Repair Device

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Introduction

The art of meniscal repair has evolved extensively over the past decade with the evolution of implant technology. While inside–out and outside–in suture based techniques have remained the gold standard for meniscal repair, the potential for neurovascular complications and increased surgical time have led to the evolution of implant technology. A recent step along the evolutionary ladder was the introduction of hybrid implant technology. These devices are classified as hybrid because they are suture based, but contain anchoring devices that are made of materials that would be classified as implants such as PLA or PEEK. These anchors are a replacement for the knots that are required to obtain tension with a suture based technique, allowing the surgeon to complete the repair arthroscopically. To complete the repair, these devices require the use of a pre–tied sliding knot or a polymer implant that is located on the articular surface of the meniscus. Most recently, the next generation meniscal repair device has been developed that completes an all-inside, arthroscopic meniscal repair utilizing 100% suture and no pre–tied knot on the articular surface of the meniscus. This device, called the MaxFire™ Meniscal Repair Device, utilizes suture sleeves that when tensioned are able to anchor themselves to the back of the meniscus. The tension is achieved through the use of knotless ZipLoop™ Technology that gains tissue compression without the use of a pre-tied sliding knot. Products utilizing ZipLoop™ Technology have been used for a myriad of surgical repairs including knee ACL reconstruction, ulnar collateral ligament reconstruction of the elbow, syndesmotic fixation of the ankle and AC joint reconstruction of the shoulder.

Product Design Characteristics

The MaxFire™ device consists of a 2–0 ultra–high molecular weight polyethylene suture utilizing Ziploop™ Technology to create a mattress stitch across the front of the meniscus. The anchors are made of a #5 polyester suture that when tensioned form mulberry knots on the back side of the meniscus. Considering that the MaxFire™ implant is expected to achieve the same results as the hybrid devices currently available, it is essential that this device be tested to prove similar strength and slippage characteristics. There have been two independent biomechanical studies comparing multiple all-inside meniscal repair devices.[1,2] The MaxFire™ device demonstrated similar pull–out strength to the Smith and Nephew FasT-Fix® device and significantly higher pull–out strength compared to the Depuy Mitek RapidLoc® device (Figure #1).

Additionally, after being cycled 500 times, the MaxFire™ device had similar slippage characteristics, strength and stiffness compared to the FasT-Fix® device but superior to the RapidLoc® device.[2]

Test #1 Bovine Meniscus[1]

Product	Load to Failure
MaxFire™ device	Horizontal Mattress–139 N
	Vertical Mattress–145 N
FasT–Fix® device	Horizontal Mattress–107 N
	Vertical Mattress–125 N
RapicLoc® device	70 N

Test #2 Porcine Meniscus[2]

Product	Load to Failure
MaxFire™ device	Vertical Mattress–129.6 N
Ultra FasT–Fix® device	Vertical Mattress–120.9 N
RapidLoc® device	40 N

Figure #1: Results of Load–to–Failure testing of the MaxFire™ Meniscal Repair Device vs. Hybrid Meniscal Repair Devices

Summary

The MaxFire™ Meniscal Repair Device is a next generation hybrid device that is able to achieve similar results to current hybrid technology while being composed of 100% suture and utilizing ZipLoop™ (knotless) Technology instead of pre-tied sliding knots. The elimination of polymer and surface knots minimize potential intraarticular complications without compromising the biomechanical properties of fixation. When reviewing any biomechanical study ensure the authors used a valid testing model and scrutinized their data carefully to make sure the devices were properly used. Furthermore, pull–out strength and mode of failure should always be reported and discussed to ensure the results represent true implant fixation and performance. Outliers and large standard deviations should be identified and an explanation provided for these specific findings rather than simply averaging data points to blend in the outliers.

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[1.] Biomechanical Comparison of Meniscal Suture, Meniscal Repair Devices and Techniques. Brian Aros, M.D., William Vasileff, B.A. Alan Litsky, M.D., Sc.D., Angela Pedroza, M.S., David Flanigan, M.D. Ohio State University MCDay, 2008. Bench testing is not necessarily indicative of clinical performance.

[2.] Biomechanical Testing of New Meniscal Repair Techniques Containing Ultra High Molecular Weight Polyethylene Suture. F. Alan Barber, MD. Morely A. Herbert, PhD., F. Alexander Schroeder, MD, Jorge Aziz-jacobo, MD, Michael J. Sutker, MD. AANA Summer Meeting June 2009. Bench testing is not neces sarily indicative of clinical performance.

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