Historically, sutures have been employed in ophthalmic surgery since the late 1800s, when Williams (1865) and Kuhnt (1883) proposed the use of fine silk thread to close corneoscleral incisions in cataract surgery. However, it was not until the 1930s that novel techniques for sterilization, combined with advances in the chemical industry, allowed for the reliable production of medical grade synthetic threads (ie, composed of organic polymers). These innovations also allowed modifications to thread design, diameter, and composition aimed at altering key performance parameters such as tensile strength, tissue drag, absorbability, and pliability. Indeed, a review of current ophthalmic suture catalogs reveals an extremely wide variety of options (Figure 1).

Sutures should be regarded as surgical devices. They are used in ophthalmic surgery to close wounds, anchor devices such as glaucoma drainage implants and intraocular lenses, provide traction, and ligate vessels or tubes. They are not intended to provide long-term structural support to tissues or to close wounds that are under extreme tension, infected, or friable. Because they are a foreign body, effort should always be made to minimize the quantity and bulk used.

The tensile strength of a suture is a critical mechanical property. In general, a suture’s tensile strength should closely match, but not greatly exceed, the tissue’s tensile strength and the stress to which it is subjected. For example, human extraocular muscles generate a maximum force of approximately 100 g. The use of substantially stronger threads confers no additional structural benefit and only adds bulk. However, much more biomechanical research is needed to establish normative tensile values for ocular tissues and the relative effects of the many different factors that may be in play in pathological conditions and aging.

The unit tensile strength of a thread is defined as the axial force required to rupture the thread (eg, unknotted 6-0 polyglactin 910 will break at approximately 625 g) divided by its cross-sectional area. The effective tensile strength is reduced approximately 50% by the presence of a knot (ie, knot breaking strength), with the weak point at the base of the knot. Acute kinking of the thread at the knot combined with compression of the fiber creates this weakness.

Several other key performance properties should play a role in thread selection. Three of the most important properties include pliability, tissue drag, and
absorbability. Pliability, or stiffness, refers to the ease with which a thread can be deformed and easily knotted. It is an important handling characteristic and is generally better with braided threads compared to monofilaments. It tends to decrease as thread diameter, or gauge, increases. Highly pliable threads, such as silk, polyglactin 910, and polyester, are easily knotted and demonstrate little memory. Although there is no direct relationship between pliability and tensile strength, braiding allows high tensile strength with retention of significant pliability.

Tissue drag reflects the frictional properties of the thread. Monofilament threads such as nylon, polypropylene (eg, Prolene; Ethicon, Inc., Bridgewater, NJ), and polydioxanone (eg, PDS; Ethicon, Inc.) demonstrate much lower tissue drag than braided threads (eg, silk, polyglactin 910, Dexon [Medtronic, Inc., Langhorne, PA], or polyester). Although tissue drag is usually an unfavorable handling characteristic, increased friction between threads or between the thread and tissue may help to secure the knot and prevent sliding while the knot is being constructed. Tissue drag is substantially reduced in some braided sutures by the application of surface coatings, such as calcium stearate on polyglactin 910 or wax on silk.

Absorbability, or degradability, is another critical parameter. Although most sutures will degrade over time, those that lose more than 50% of their initial strength in less than 60 days are considered to be absorbable. Synthetic absorbable sutures are broken down by hydrolysis, whereas gut sutures, which are made from purified strands of bovine serosa or sheep intestinal submucosa, are broken down by proteases. The kinetics of absorption depend on chemical composition, the presence of additives (eg, chromium salts on gut), and the suture gauge.

Absorption is a gradual, continuous, approximately linear process that begins immediately. Tensile strength diminishes more rapidly than suture bulk. For example, 6-0 polyglactin 910 loses 50% of its initial tensile strength in approximately 3 weeks. It is important that the rate of absorption be as closely matched to the kinetics of the healing process as possible. The ideal suture would provide 100% of its intended tensile strength for the amount of time it is needed, then rapidly and completely disappear. Although it is not yet possible to customize sutures to this specification, it is not unreasonable to assume that continued technological advances will ultimately make this a reality.

Selecting the most appropriate suture for a given situation clearly depends on many factors. Matching the biomechanical and healing parameters of the specific ocular tissues with the performance properties of the various threads and needles makes sense. So, the next time you ask for a suture, think about why it is the best choice. Make every bite count.

TO LEARN MORE

SEMINAL ARTICLE
Williams HW. Suture of the flap after the extraction of cataract. Trans Am Ophthalmol Soc. 1866;1:45-46.

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