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Major review

Techniques, indications and complications of corneal debridement

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ABSTRACT

The cornea is the most exposed surface of the eye and, as such, is vulnerable to external trauma and the risk of infection. Many corneal diseases alter shape, surface, and transparency and thus result in reduced vision. The external position of the cornea, however, lends itself to diagnostic and therapeutic maneuvers that are commonly performed and readily done in the clinic. More sophisticated techniques require the use of complex equipment such as excimer and femtosecond laser. Complications that develop from poor healing and/or secondary infection are best avoided with appropriate technique, antisepsis, and modification of wound healing. We review corneal debridement in the management of corneal disease.

1. History

Erasmus Darwin, grandfather of Charles Darwin, was the first in the English literature to suggest therapeutic debridement of the cornea. In a 1795 letter to Thomas Wedgwood he wrote, "[An] idea is with a sharp knife, to shave or pare off the external part of the opake [sic] cornea, till it becomes transparent, like scraping ivory or horn quite thin, and try if it would become opake again" (pp 95.2–95.3).[75] Parker, in 1894, reported two cases of bullous keratopathy cured by light application of the galvanocautery to the entire corneal surface.[108] Four years later, Ranvier performed the first demonstration of the mechanical sliding of adjacent epithelial cells across a denuded area of human cornea.[112] With better understanding of corneal physiology, the 20th century brought significant advances in the diagnosis and therapy of corneal disease.

Franke, in 1907, was the first to suggest the removal of the corneal epithelium as a therapeutic treatment for corneal basement membrane dystrophy.[42] Over 75 years later, in 1983, Trokel discovered that excimer laser light could be used to reshape and ablate corneal tissue in a more controlled manner.[138] Today, a combination of the techniques proposed over the past two centuries form the cornerstones of the

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ophthalmologist's armamentarium in the diagnosis and treatment of superficial corneal pathology.

2. Techniques

2.1. Blade/Needle

Fundamental to the removal of foreign matter from the cornea, for therapy or diagnosis, is the method adopted to collect the material. A (21–25 G) needle, Beaver blade No. 64 or 57 (Beaver-Visitec International, Waltham, MA) and Bard Parker blade (No. 11 & 15) (BD Medical, Franklin Lakes, NJ) are the most common tools used. Typically, these instruments are reserved for techniques involving the removal of solid foreign objects embedded in the superficial cornea or for collection of infective tissue for microbiological evaluation. Debridement should be done under topical anesthetic at a slit lamp biomicroscope or with the aid of magnifying loupes and a good light source. The sharp edge of the instrument is held tangential to the surface to keep the debridement superficial, thereby reducing the risk of corneal perforation. The Bard Parker blade No. 15 has a shape that allows material to be obtained with relative ease, comes in a sterile single-use package, and is inexpensive. Lim et al describe a technique for corneal foreign body removal that involves bending the tip of a 25 G needle to 90°, increasing the safety and simplicity of debridement.[85]

The use of a blade or needle allows material to be obtained from the leading edge of an ulcer and, by debriding the surface layer, may allow detection of organisms from deeper in the stroma.[73] The Bard Parker blade No. 15 and 21 G needle are useful tools for the collection of infected epithelium for the diagnosis of microbial keratitis (Fig. 1).[54,81,122] Garg feels, however, that a 21 G needle is a poor option for cornea debridement as there is a higher risk of perforation in necrotic corneas.[43] The blade or needle should be scraped over the surface in a series of short, firm strokes from the peripheral margins toward the center of the corneal ulcer to sample both the leading edges and the base of each infiltrated area.[13]

When the Beaver blade is used for epithelial removal in photorefractive keratectomy (PRK), Weiss et al advocate short, rapid, gentle movements of the blade across the cornea to remove epithelium from the periphery toward the center.[1,145] Epithelial debridement prior to PRK must be fast, effective, safe, and able to leave a smooth Bowman layer in order to obtain a successful outcome. A blade has the advantage of complete epithelial removal, but this is highly dependent on surgical skill to complete quickly without damaging Bowman's membrane and exposing the stroma to dehydration.[52] Blades tend to leave microscopic scratches in Bowman's membrane.[1,19,52] Mechanical debridement can also result in ragged edges and a larger than intended ablation diameter.[1]

2.2. Ophthalmic sponge

Sponges have been used in ophthalmic surgery since the early 1980s.[93] The Microsponge (Alcon Laboratories, Fort Worth, TX) consists of methylcellulose in a spear shape of 7 mm base and 17 mm long. Sponges of this material are produced by numerous companies worldwide under various names. Ophthalmic sponges can also be made from polyvinyl acrylate. The sponge is typically used to debride corneal epithelium that is already loose or has been loosened by application of alcohol. Poorly adherent corneal epithelium surrounding a defect or ulcer can be easily removed in this safe and relatively non-invasive technique (Fig. 2).

2.3. Diamond burr

The electric corneal drill, a rotating dental burr, was first introduced for the removal of corneal rust rings in 1936, with subsequent addition of a diamond-dusted tip.[147] Diamond burrs are hand-held, battery-operated instruments with spherical tips of 0.5–5.0 mm diameter. Although specifications vary with manufacturer, rotation speeds average 10,000 rpm, and the diamond-dusted tips are disposable or can be cleaned ultrasonically and autoclaved. Polishing with the diamond burr may be performed with or without continuous irrigation.[107]

Burrs are favored in some centers for the removal of metallic rust rings or scars in the corneal stroma.[85] Diamond burr keratectomy, first used to treat a corneal dystrophy in 1983, is also an effective tool in the management of epithelial

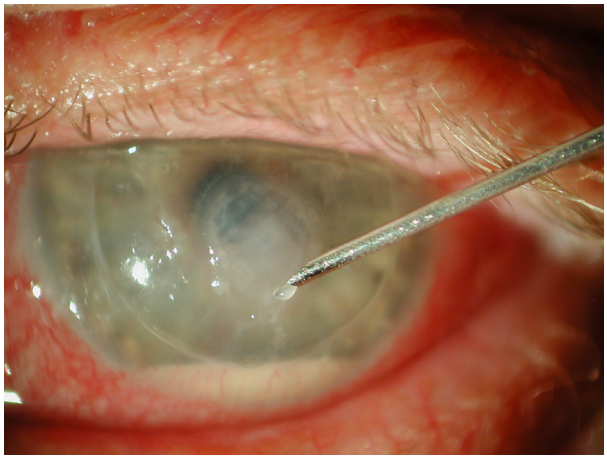

Fig. 1 – Corneal scraping with a 22 G needle for diagnostic sampling of a bacterial keratitis.

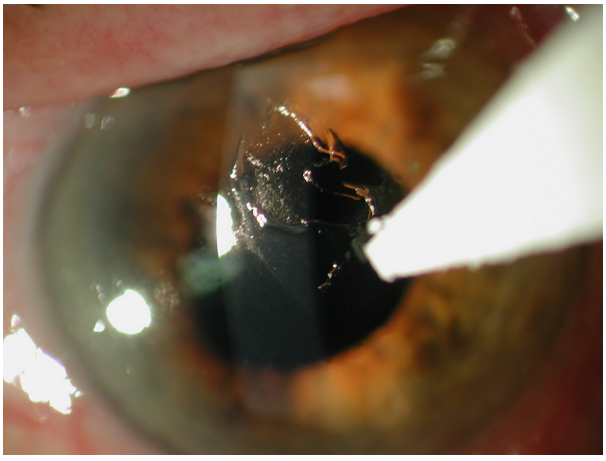

Fig. 2 – Debridement of loose corneal epithelium with a Microsponge for recurrent corneal erosion.