Arthroscopic powered instruments: a review of shavers and burrs

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Abstract

There has been rapid development in the field of arthroscopic surgery in the last decade. Hand in hand with this the instrumentation has also become more specific and sophisticated. Powered arthroscopic instruments such as shavers and burrs are commonly used in all forms of arthroscopy and a large range is now available to the orthopaedic surgeon. This large array can cause confusion, especially since many have very specific intended functions. This article reviews the types of blades and burrs available and the principles underlying the mechanism of how they work. A better understanding of the subject should hopefully make the surgery easier and also minimize the potential damage these instruments can cause.

Keywords arthroscopy; blades; burrs; instruments; shavers

Introduction

The evolution of arthroscopic surgery has been one of the major developments in orthopaedic surgery in the recent past. It has dramatically changed the orthopaedic surgeon's approach to joint pathology. A high degree of clinical accuracy combined with low morbidity has encouraged its use in diagnosis, assessment and treatment.

Progressive improvements in arthroscopic systems, equipment and accessory operative instruments, such as powered cutters, have made advanced intra-articular operative techniques possible.[1]

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The demand for appropriate and specific instrumentation is increasing.

Arthroscopic shavers have become increasingly important in routine arthroscopic work, both for improving visualisation and also for therapeutic work. However, to use these instruments safely and optimally a sound knowledge of their specific function and mode of action is required.

History

Powered cutting instruments have been proven to be extremely useful in arthroscopic procedures. The first such power-driven device was a patellar shaver that was introduced in 1975 by Dr. Lanny Johnson[2] and made by Dyonics Corporation (Figure 1).

Shaver blades and cutting tips

Shaver blades with a wide range of cutting tips have been developed by the orthopaedic instrument companies. They are designed for use in different clinical situations and for specific functions. However, the principles of the design remain similar (Figure 2).

Blades

The blade consists of an outer hollow sheath and an inner hollow rotating cannula with corresponding windows for suction and cutting; a "tube within a tube" mechanism.[3] The window of the inner sheath functions as a two-edged cylindrical blade that spins within the outer hollow tube.[1] The shape and geometry of the edges of the inner and outer tube tips determines the degree of aggression of the blade.

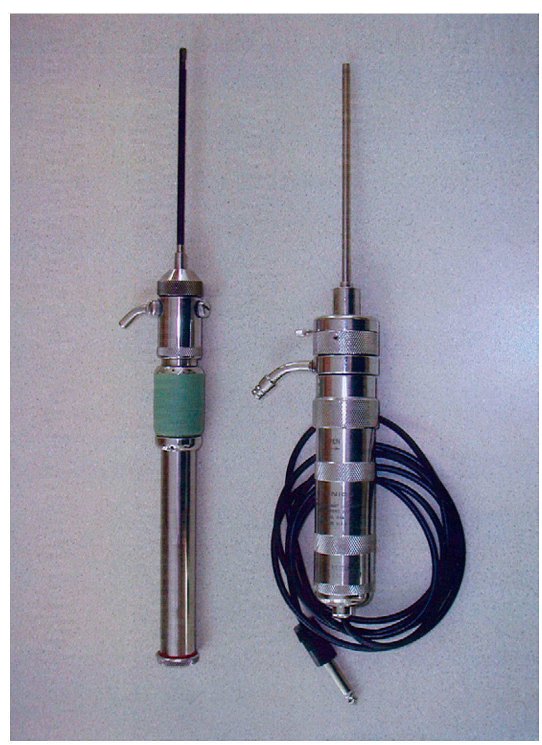

Figure 1 Photograph of first patella shaver (Dyonics Corporation). A shaver system consists of a number of components, broadly these include: A. Shaver blades with variable cutting tips and shaft. B. A Hand piece and grip. C. A Power source. D. Irrigation and suction.

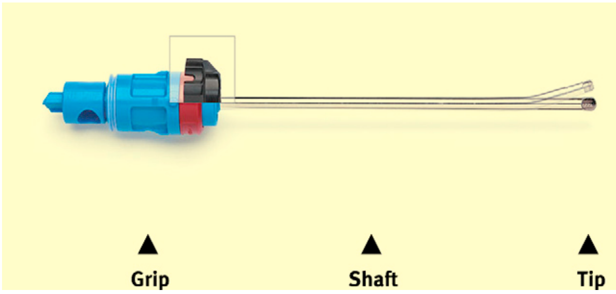

Figure 2 Different parts of a shaver blade.

They are available in standard and long lengths, curved and straight styles, and shaft diameters ranging from 1.9 to 5.5 mm, depending on the joint involved and the procedure to be performed. Smaller blades allow access to smaller or more constrained joints.

We have tried to broadly divide the shavers according to the type of tissue they cut, though there is some overlap:-

(I) Blades designed for cutting soft tissue

These function best at lower speeds, in the range of 1800–2000 rpm in the oscillate mode. Because these tips require tissue to be introduced into the opening of the outer tube, higher revolutions per minute effectively close the aperture and permit insufficient time for soft tissue fragments to enter. Unless the blade is extremely sharp, the internal component will push firmer tissue back out of the aperture or will spool thinner tissue without cutting it.

The key points in design when selecting a soft tissue shaver blade include:

- **Size of the aperture:** This is the window at the tip, which can be large, as in a full radius blade, or smaller. The larger the window the greater the ability to resect tissue.
- **Location of aperture:** 'Side cutting' is the normal mode of function in most shavers as access is normally tangential, but additionally some designs allow 'end cutting' when only almost perpendicular access is possible. End cutting is normally prevented in most shavers by a hood at the tip of the shaft. Choosing the right design is crucial to avoid collateral damage within the joint.
- **Edges of the aperture:** The design of the edges of the soft tissue blade can affect its role. There are generally three designs with increasing levels of aggressiveness (Figure 3):
  a) smooth inner tube and smooth outer tube,

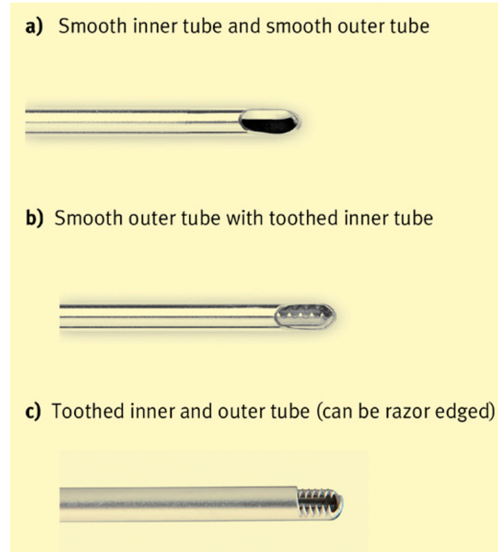

Figure 3 Different cutting tips give the shaver different levels of aggressiveness (Courtesy: Smith & Nephew). **a** Smooth inner tube and smooth outer tube. **b** Smooth outer tube with toothed inner tube. **c** Toothed inner and outer tube (can be razor edged).

  b) smooth outer tube with toothed inner tube, and
  c) Toothed inner and outer tube (can be razor edged)

(II) Blades designed for bony resection

These perform best at speeds of about 5000 rpm in forward mode. The deeper the flute pattern in the burr, the more important higher speed becomes. Deep flutes, widely spaced, tend to chatter and vibrate at lower speeds. Shallower flutes turning at higher speeds present inadequate cutting surface to the tissue. Cutting, therefore, becomes a function of the angle at which the burr edge approaches the bone surface and the velocity at which it turns.[3] The burrs generally cut better on forward but they can be used to polish a surface on reverse. The newer designs provide an outer coating on the blade that works as lubricant. This prevents and reduces the release of metal debris when using the blade against a hard surface.

The two different designs of burr blades are:

(a) Barrel Shape: used in standard procedures such as acromioplasty. With these, the less the number of flutes, the more

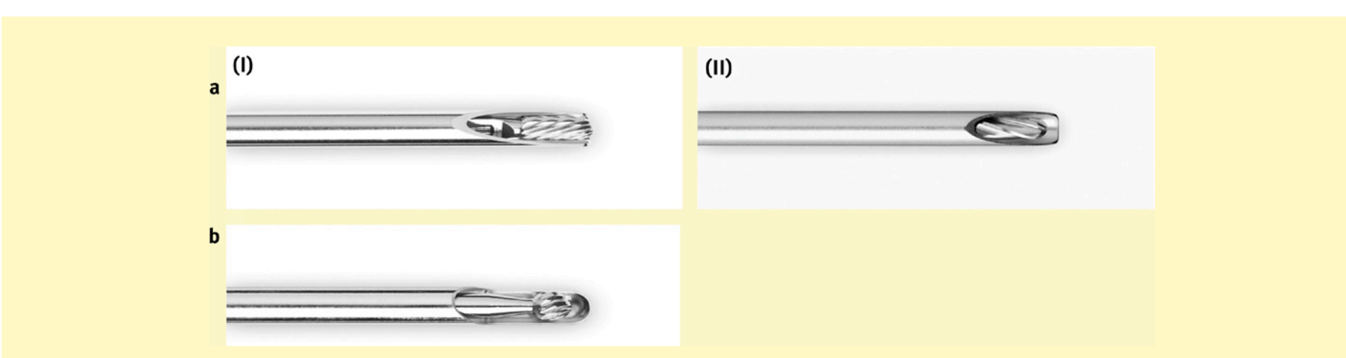

Figure 4 a Barrel shaped burrs for acromioplasty with different flute and end cutting designs. Note the V-shaped flutes (in II) vs. diagonal ones (in I). **b** Shielded ball burrs. (Courtesy: Smith & Nephew).

