OPHTHALMIC SURGICAL SUTURES AND NEEDLES

Thesis

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the Master Degree in

(OPHTHALMOLOGY)

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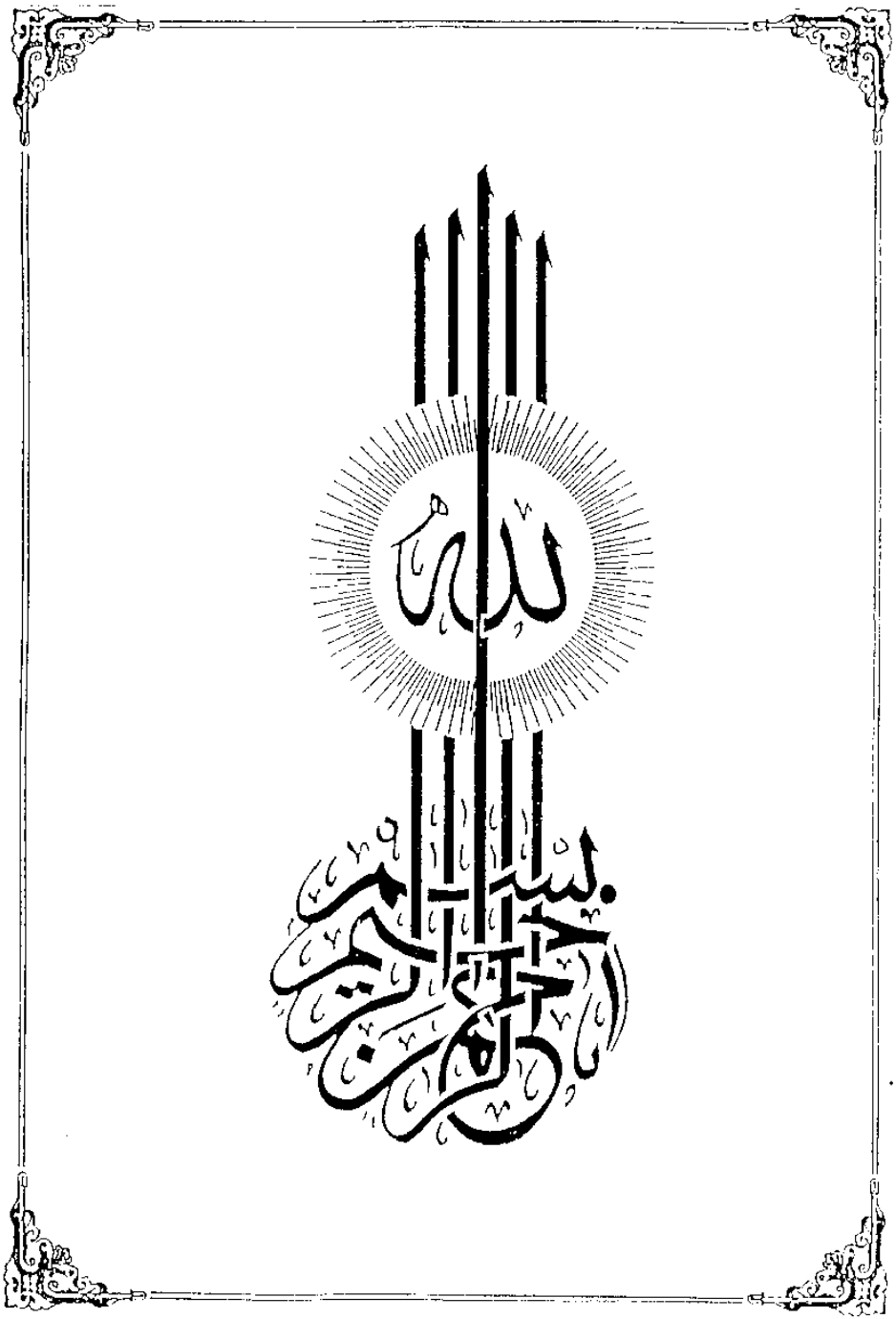

Introduction

Surgical needles are made from either stainless steel or carbon steel, the latter usually being plated to resist corrosion. At one time the carbon steel needle had a better resistance to bending than its counterpart in stainless steel, but recent technological advances have improved stainless steel needles and they now compete in strength with carbon steel and have the added advantage that they afford resistance to corrosion. In case of sharp ophthalmic needles, even microscopic corrosion can dull the fine point and cutting edges. Moreover, carbon steel tends to lose its point and edge sharpness to a greater degree than stainless steel on repeated passes through tissue. Nowadays, stainless steel is most popular. Recent developments include the application of a microthin layer of plastic to the needle surface, providing for easier penetration and a reduction in drag of the needle through the tissue *(Rawlins, 1982)*.

Anatomy of Ophthalmic Needles

ANATOMY OF AN OPHTHALMIC SURGICAL NEEDLE

There are seven basic parts to any needle:

a) Swage.
b) Wire diameter.
c) Needle length.
d) Radius.
e) Chord.
f) Point.
g) Degree of circle.

a) Swage (Fig. 1) This is the joining and the attachment of the suture to the needle. It is of great importance, since this joint must be strong enough to withstand needle pull and yet not add bulk that would increase the needle butt diameter over the needle wire diameter and impede smooth passage. This is best accomplished by drilling or by crimping the butt end of the needle to hold the thread end. The thread is fixed in place by epoxy glue or by the crimp.

Some excellent eyed needles are still available. Their wire diameter may be excessive because a certain bulk is necessary to be able to drill out the eye of the needle. The eye itself must be smooth or the suture will be cut as the needle is pulled through tissue. They are useful mainly as secondary needles if a swaged needle should become damaged or separated from its thread *(Troutman, 1974)*.

According to *Jaffe (1972)*, he recorded that suitable swaged needles are preferred to eyed needles because they are less traumatic to the tissue. Threaded, eyed needles require the introduction of at least a double strand of suture through the tissue. In a swaged needle, a single strand of suture material is firmly encased within the shank of the needle. In eyed needles, the top of the eye should be flat rather than round. This prevents the suture knot from migrating down the side of the eye.

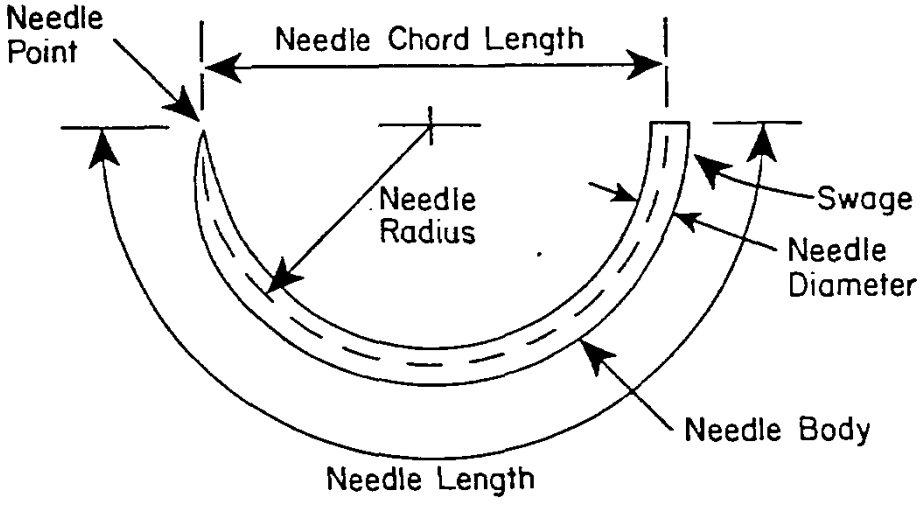

Fig. 1: Basic points for consideration when choosing surgical needle (Anatomy of Surgical needle).
[From: Speath (1982): Ophthalmic Surgery principles and Practice, P. 70].

On the other hand, *Harms and Mackensen (1967)* denoted that much attention has been paid to the eye of the needle, whether it has a groove for the suture on both sides or on only one side. If very fine suture material is used, this is probably unimportant. It has been pointed out that a suture tied to the needle could slip to one side and in this way increase the diameter of the needle itself *(Castroviejo, 1965)*. This eventuality probably depends upon the thickness and flexibility of the suture.

b) *Wire diameter* (Fig. 1) Needles start as a piece of wire. The needle diameter is the diameter of the wire from which it is made. For ophthalmic needles, the general range is from 0.15 mm (.006 inches) to 0.43 mm. (0.17 inches) *(Alcon laboratories, Inc. prints, 1981)*.

c) *Needle length* (Fig. 1) The distance around the outside curve of the needle from the position where the suture is attached to the point of the needle *(Alcon laboratories, Inc. Pritns, 1981)*.

d) *Radius* (Fig. 1) The distance from the center of an imaginary circle that would be formed by the needle, if it were completely round, to the middle of the needle wire *(Alcon laboratories, Inc. Prints, 1981)*.

e) *Chord* (Fig. 1) The straight line distance from the point to the opposite end of the needle it largely determine the depth of the needle tract *(Alcon laboratories, Inc. Prints, 1981)*.

f) *Point or tip* (Fig. 1) This is the part of the needle that first penetrates tissue. It is usually sharpened (except in certain types of blunt needles). *Troutman (1974)* proposed that the point can be likened to the tip of a spear, its tapered trailing cutting edges comprising the anterior 2 mm of the needle. The shaft, or the

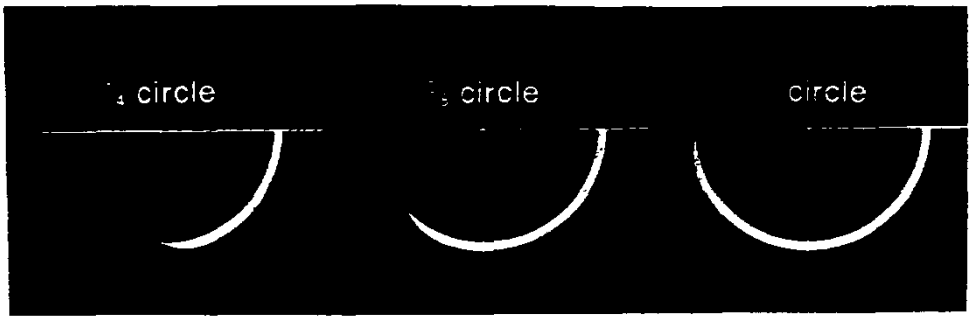

Fig. 2: Degree of circle.
[From: Ethicon Inc. Prints (1979): Selection and use of needles].

remainder of the needle body posterior to the broader cutting taper, is of uniform diameter.

The cutting tip is first flattened and then sharpened. As the result of metal loss when forming and sharpening the point and blade, the tip of the needle is of slightly less bulk than the shaft. Electropolishing the needle during the final manufacturing process also can remove metal, and therefore the finished wire diameter is probably a little less than that of the shaft.

The point and cutting edge of the needle tip are formed by automatic machinery. First, one end of a cut piece of straight wire is sharpened to a point. The cutting edge is formed by grinding four sides off the round, producing a rhomboid-shaped cross section with the trailing cutting edges of the needle being to either side of its broader upper aspect. The point has the final shape of the bow of a boat with the prow at the same level as the cutting edges. The shape of the point and its trailing cutting edges tend to force the tip of the blade up toward the curve of the needle, preventing inadvertent deep penetration. However, surgeon must be aware of this characteristic of the tip design and compensate for it when entering, passing, and exiting the needle.

(Troutman, 1974)

g) *Degree of circle* (Fig. 2) It is usually called circle. The most common are:

i. 1/4 90° to 125° circle needles.

ii. 3/8 120° to 160° circle needles.

iii. 1/2 160° to 180° circle needles.

These designations are general. For example, needles whose arcs cover from 85° to 115° may be called a quarter circle needle (90° is exactly 1/4 of a circle) *(Alcon laboratories, Inc. Prints, 1981)*.

However, the choice of needle shape is frequently governed by the accessibility of the tissue to be sutured, and normally the more confined the operative site the greater the curvature required *(Ethicon Inc. Prints, 1979)*.

Troutmant (1974) denoted that if the surgeon is not aware of both characteristics of the tip design and degree of circle and does not compensate for it when entering, passing and exiting the needle, he inadvertently may pass the needle more superficially than was his intention. This tendency is best compensated, not by trying, consciously to change the needle direction by twisting the needles holder, but rather by selecting a needle of the curve necessary to attain the intended depth of placement without having to force the direction of the needle or to distort the tissue passage. In general, the steeper the curve of the needle, that is, the shorter the needle radius, the more deeply it will pass it is important to remember that once the initial penetration has been made, the needle moves more easily through tissue when the surgeon imparts a pushing rather than twisting motion to the needle. This is further eased if a different needle curvature is used for different depths of passage.

The Needle Shaft

Between the sharpened point of the needle and the swage is the shaft or body. The shaft of the needle may be round or flattened on one aspect so that it does not twist or turn in the needle holder *(Trautmont 1974)*.

Needle strength

According to *Ethicon Inc. Prints (1979)*. The diameter of the wire from which the needle is manufactured is a major factor in determining its strength, although the cross-sectional shape and type of wire are also important. Dependent

on the requirements of the surgeon and the tissue to be sutured, a close relationship between needle diameter and gauge of suture material may be paramount, whilst in other situations the strength of the needle may be more important. A further factor to be considered in needle strength is the situation where a force is applied greater than that for which the needle has been designed. Surgical needles are made of malleable steel so that they will tend to bend rather than break when this critical point is reached or if the shaft is inadvertently twisted in its passage. Needle bending is an indication, therefore, that this critical point has been passed and needle should be discarded rather than any attempt made to straighten it.

Types & Special Designs of Ophthalmic Needles

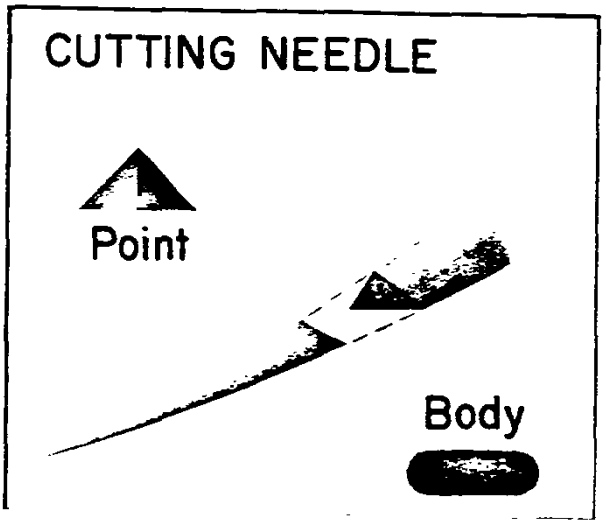

Fig. 3: The Conventional Cutting Needle.
[From: Speath (1982): Ophthalmic Surgery Principles and Practice, P. 71].