Surgical needles

•Introduction

The needle which is attached to surgical suture consider one of the most important factors in surgical procedure success; according to needle quality and appropriate choice of needle for each surgery. Surgical needle commonly fabricated from stainless steel; the stainless steel contains chromic to make needle corrosion resistant. The hardening process is obtained in many ways like; heating and air quenching (quick cooling) of metal, or by precipitation of intermetallic compounds like Ni_3Ti.

There are a lot of types of stainless steel to manufacture surgical needles like AISI 420 and AISI 302, all of them contain different properties according to stainless composition. many different types, sizes and shapes of surgical needles are available, and surgeon's choice of the appropriate needle depend on:

1. The nature of wound or tissue which will undergo surgery and operative area.
2. proper balance with suture material size whereas the surgical needle must be able to carry the suture material through tissue with minimal trauma.

Whereas the inappropriate use of surgical needle type can lead to tissue injury or wound such as use of the reverse cutting needle at ophthalmitis surgery like sclera which can cause injury to eye choroidal, generally the needle should be:

- Rigid enough to prevent bending or distortion with some flexibility to bend before breaking, as the greater needle strength prevent tissue trauma.
- High sharpness to ensure easy and rapid tissue penetration.
- Good structure to easy retrieve the needle from tissue in order to reduce tissue injury.
- smooth profile, so needle is coated with silicon to reduce friction, facilitate penetration and give more glide.
- Sterile, and corrosion resistant to prevent microorganism and foreign material of making any contamination to the wound.
- Appropriate to grasp by surgical equipment like needle holder or forceps Particularly surgical needles should manufacture as slim as possible with a good strength to provide high quality and all of surgical criteria.

•*Needle anatomy*

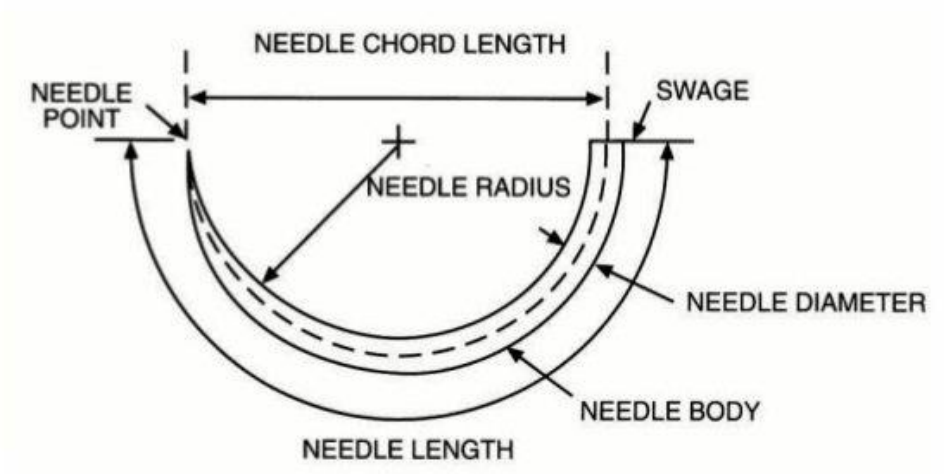

Figure-1-Cross section of needle

1. needle chord length: straight line distance from the tip to the end of needle
2. needle length: the distance at needle itself between the tip and the end of needle
3. radius: distance from the center of circle to the body of needle
4. needle diameter: the thickness of the needle wire and its measurement with micron or mm and the less thickness cause less trauma during passage through the tissue

•Basic needle design

All of needle divided into: 1-eye or swage -2- needle point -3 -needle body

1-Eye or swage:

1.1-Eyed needle:

the old fashion of needle had an eye, the suture threaded with needle through the eye during surgery. this method is economical because the needle can be reusable, however the sharpness will be less in this case and big hole and more damage to tissue can be caused because the passage of double strand suture and pulling it through the tissue causes more tissue trauma, that's why this needle called "traumatic".

Figure-2- Convectional eyed needle

2.1-Eyeless needle (swage):

All of needle nowadays are swaged, suture is directly attached to needle by manufacturer. Needle has a hole or channel formed in the end of it, and for ideal needle the hole is drilled with laser to provide more smooth transition with suture. thus, the suture material follows the needle through the tissue without causing a tissue injury, and the thickness of needle and suture is less than eyed needle, that's why this needle is called "atraumatic"

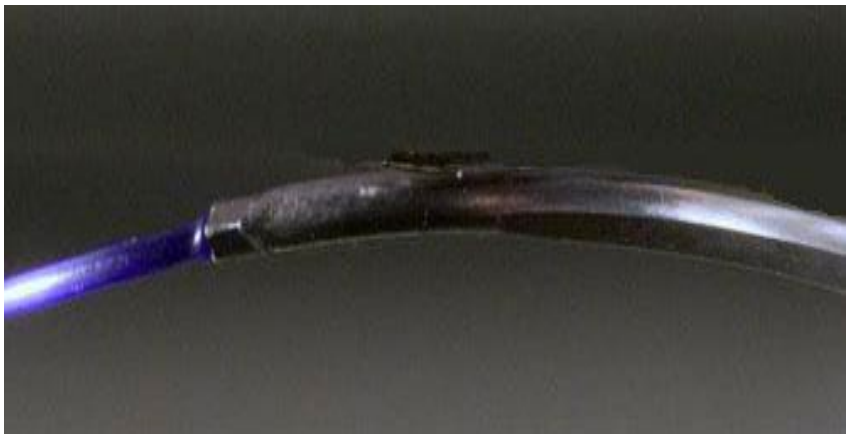

Figure-3- Swaged needle

2-Needle body:

The needle body part of needle contains the most of needle length. It's the portion which grasped by needle holder during surgery, there some factors in needle effect with this function include needle diameter, radius and body geometer. Needle

body help the point to facility tissue penetration according to the body shape (round or triangle). Diameter of body should be as close as possible to the diameter of suture material to prevent tissue trauma and minimize bleeding and leakage. Needle body include four type:

- Straight body
- Half-curved (ski body)
- Curved body: 1/4 circle, 1/2 circle, 3/8 circle, 5/8 circle.
- Compound curved body

3-Needle point:

Needle point is a portion of needle exist at needle tip, consider one of sharpness factors whereas a sharpness related to angel of point and taper ratio, all of needles with a taper point or have cutting edge. The type of needle point includes:

- Cutting needles include (conventional, reverse and spatula): the cross section of cutting needles are triangle and uses for fibrous or dense tissue
- Taper point (round body) needles: these needles designed to penetrate the tissue without cut and used for soft tissue which damaged with cutting needle
- Blunt-point needles: the point of these needles is not sharp as standard to prevent sticking needle damaging.

•*Needle shape (curvature)*

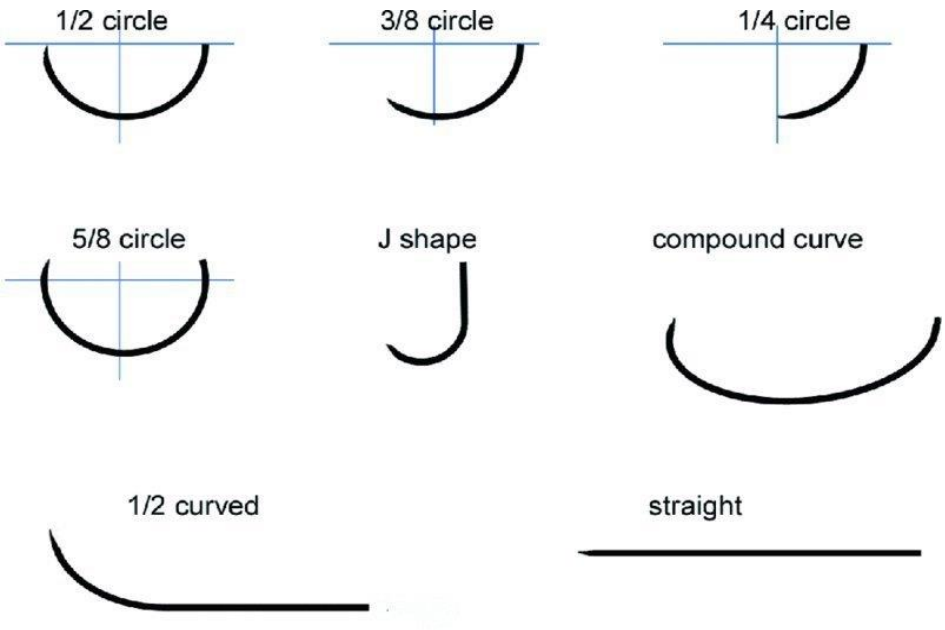

Figure-3-needle shape

Needle may be straight or curved and curvature according to circle angle, divided to (1/4 circle, 1/2 circle, 3/8 circle and 5/8 circle). The choice of needle shape always dependent to the accessibility of tissue which will undergo surgical procedure, the more confined surgery site requires more curvature.

The most common shapes are:

1-Quarter circle:

It has a little curvature, use on convex surface and delicate surgery, typically use on ophthalmic procedures, facial aesthetic, eyelids, fascia, and microsurgery.

2-One-half circle:

It has a large arc to use in confined sites, the application area is skin, muscle, peritoneum, eye, abdominal surgery and gastrointestinal tract.

3-three- eighths circle:

The most common needles use in large and superficial wound and it's impossible to use in deep cavities. This needle applied in skin, hand surgery, fascia, muscle, subcuticular.

4-five-eighths circle:

These needles perfect with deep and confined cavities due to the needle design make a maneuvering in small location easier. Application area Intraoral, urogenital, and anorectal procedures.

5- One-half curved (ski needle):

The curved portion for this needle passes through tissue easily, used in laparoscopic technique and skin closure.

6-j shape needle:

Used on deep incision so it used in laparoscopic surgery without any injury to visceral and applied in vagina and rectum.

7-compound curved needles:

Used on oral, eye and anterior segment ophthalmic surgery.

8-straight needle:

Can be used without needle holder as is the case of curvature needle and there is a high risk of accidently sticking yourself. It uses in easily accessible tissue, typically in abdominal surgery, rhinoplasty.

•*Needles type according to body and point of needle*

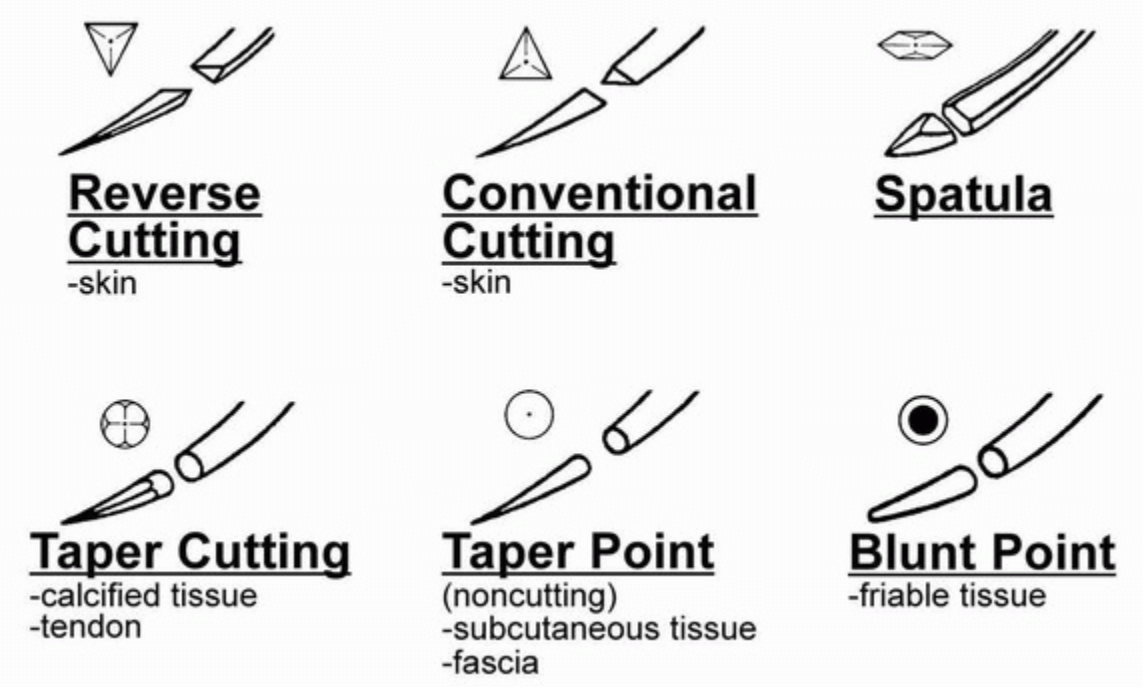

Figure-4needle type and some uses of them

1-taper-point needle:

these needles designed to provide good penetration to soft tissue, after needle passes through the tissue the tissue closes tightly around suture material which forming leak-proof suture line. Needle holder position is between needle point and attachment area this position confers more stability to needle held. Its available with wide range of diameter the finer diameters good for softer tissue like gastrointestinal and vascular, High diameters is good for tougher tissue such as muscle.

2-Blunt taper point:

This type is not as sharp as standard needle whereas the blunt needle has been designed to reduce the risk of needle stick injury, used in all surgery which contain vary friable tissue such as the liver and any specialty that includes surgery of the muscle or fascia.

3-taper-cut needle:

This needle like two needles in one with round body to reduce the trauma to wound and with cutting tip to improve the penetration and the cutting tip is limited to the point of needle, they are not recommended for

suturing skin.

4-Reverse cutting needle:

This needle has a triangle shape body, the triangle apex in outer side of the curve concave, with sharp edge on the outside curvature help to cut the wound with three edge on sides, utilize specifically for tough and default penetration tissue such as skin, tendon sheath, or oral mucosa and ligament.

5-conventional cutting needle:

This needle Has a triangle shape like reverse cutting but the triangle apex in inner side of the curve concave, its suitable for most purposes atypically applied on skin, ligament, nasal cavity, tendon and oral.

6-spatula needle:

These fine needles are designed with sharp cutting edge, square, flat body from the top to bottom to reduce tissue injury whereas has easy penetration and high control passage through and between soft tissue layer and they are designed specific to ophthalmitis and oculoplastic surgical procedure.

•Needle holder

Figure-5-needles holder with different size

Medical instrument use to grasp surgical needle during surgical procedure it's make from stainless steel, titanium and tungsten carbide tip, the tungsten carbide tip caused minimize deform to needles. Correct use of needle includes:

1. appropriate balance between needle size and needle holder size whereas biggest size of needle requires heavy needle holder and for smaller needle delicate needle holder are recommended.
2. Needle holder should grasp needle away of swage or eye needle area to avoid crimping damage and needle should be grasped approximation ¼ to ½ the length from needle point side.
3. Don't close the needle holder too tightly during needle grasp to avoid break the needle.