

A Geometrical Method Applied to an Orbital Block

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Background:

At what distance should the needle tip be inserted around the globe before it can be safely redirected into the intraconal space? This fundamental question, asked by practitioners, has not been clearly defined. Will the development of a clinically applicable geometrical calculation assist the practitioner in determining the safe minimal distance to insert the needle tip before redirecting intraconal?

Method:

Geometric formula

Devise a geometrical formula to calculate in millimeters the distance to the equatorial plane of the globe from the infratemporal insertion site. Once the needle tip reaches the equatorial plane, the tangential point on a sphere, the curvature of the globe is no longer posterior to the needle. Beyond this calculated point the needle may be redirected intraconal.

Calculate the depth of the equatorial plane from the needle insertion site.

1. Calculate the length of the eyeball:

Axial length (AL) 23.5mm + Choroid/Sclera(C/S) length 1.5mm = 25mm

2. Calculate the distance to the Equatorial Plane (EP) of the globe

Length of the eyeball 25mm / 2 = 12.5mm

3. Measure: The patient's Orbital-Globe relationship;

The distance the globe extends over the infraorbital rim. This final measurement is taken by using a surgical marking pen's ruler (i.e.: Tyco-Devon skin marker and ruler) in millimeters. The pen is placed against the skin infratemporally at the superior edge of the infraorbital rim approximately 2mm lateral to the lateral limbic line.

The measurement is taken by observing the distance to the top of the cornea, average distance 8mm. **(1)**

Orbital Block Technique

The measurements are derived from the frontal plane of the orbit and directed posteriorly. Therefore, the equation is for blocks performed in the same direction,

which is lateral and parallel to the lateral limbic line/plane **without any oblique angulations.**

These techniques have been in use for over 30 years. Gills and Loyd reported their technique in 1983. They advocated a 2 to 3 injection technique first:

“A transconjunctival insertion made 5mm from the lateral canthus down to the muscle cone.

Second: “An injection in the retrobulbar space through the conjunctiva is made 5mm from the lateral canthus in line with the lateral limbic margin. A sharp 27-gauge 31mm needle is normally inserted to a depth of 25+mm.”(2)

Analyzing this needle track to the mid orbit demonstrates a lack of vital orbital structures along the projected needle path except for the globe. (3)

However, Gills and Loyd do not address the question: How deep should we insert the needle before it can be safely redirected intraconal?

The author’s technique: (4)

An infratemporal transconjunctival needle insertion is made with a 25-gauge (1-inch) needle with its bevel towards the globe, approximately 2mm lateral to the lateral limbic margin/plane (corneal-scleral junction) and approximately 2mm inferior to the globe. The needle tip is directed approximately 120 degrees towards the orbital floor, until the conjunctiva/skin is penetrated approximately 2mm. This angle avoids the needle tip pointing at the globe.

The needle tip is then redirected 90 degrees to the frontal plane of the orbit, parallel to the visual axis. Reassess your landmarks, then slowly advance the needle tip posterior approximately 0.5inches (12.5mm) passing the equatorial plane of the globe.

At this point, redirect the needle tip cephalad until the hub of the needle rests gently on the infraorbital rim about 60 degrees or less to the frontal orbital plane. Reassess your landmarks, and then slowly advance the needle tip to a depth of 25mm (1-inch), measured from the infraorbital rim.

After negative aspiration, inject the local anesthetic at the rate of about 1-ml every 6 to 8 seconds until the orbit is full, approximately 6ml.

Reversing the insertion technique and withdrawing the needle angled at approximately 120-degrees, towards the orbital floor, to avoid the needle tip pointing towards the globe.

In the absence of distance marks on the needle, the use of a 1-inch (25mm) needle allows the practitioner to visualize when approximately 0.5inch (12.5mm) of the needle has been inserted. In the author’s experience with blocks this distance has been several millimeters beyond the equatorial plane. There may be some rare circumstances when the 12.5mm is only slightly longer or shorter than the equatorial plane, therefore calculating the distance is preferable.

Results:

Geometrical formula:

Eyeball length = AL 23.5mm + C/S 1.5mm=25.0mm

Distance to the equatorial plane = eyeball length / 2 =12.5mm

Infraorbital rim to Cornea (**measured**) average example = 8.0mm

Distance from needle tip insertion to EP = 4.5mm

For ease of clinical application the practitioner should round all numbers to the next highest even whole number (i.e.: AL 23.5 to 24; C/S 1.5 to 2).

This slight elongation of the globe measurement also adds a margin of safety to the calculation.

Calculations for Author's technique:

Needle insertion depth 12.5mm - **4.5mm calculated depth to EP** = 8mm

8mm is the distance beyond the EP before the intraconal redirection is made.

Calculation examples:

AL 30mm + C/S 2 mm=32mm/2=16mm - 12mm IR to cornea (measured) = 4mm to EP

Needle insertion 12.5mm - 4mm = +8mm beyond EP

AL of 20mm + C/S 2mm=22mm/2 =11mm - 4mm IR to cornea (measured) = 7mm to EP

Needle insertion 12.5mm - 7mm = +5mm beyond EP

Both these eyes were within the safe range of a 12.5mm (0.5inch) needle insertion depth before redirecting intraconal

Blocks performed by the author utilizing the geometrical formula includes axial lengths up to 34 mm.

Conclusion:

A clinically useful geometrical formula can be used to calculate the distance to the equatorial plane of the globe, beyond which the globe, as a sphere, naturally curves away from the advancing needle tip. Utilizing the above described block technique; the practitioner may determine the depth beyond the equatorial plane they consider safe before the intraconal redirection.

In addition when the needle tip remains parallel to the visual axis, it is also lateral to the macula, optic nerve and the major vessels of the orbit.

References

1. Wolff E. Anatomy of the Eye and Orbit. Philadelphia and London: WB Saunders; 1966: 31.
2. Gills JP, Loyd TL. A Technique of Retrobulbar Block with Paralysis of Orbicularis Oculi. J Am Intraocul Implant Soc 9(3): 339-40, Summer 1983.
3. Harvey R. Parallel Approach to Orbital Blocks "Lets track the Needle Tip". Ophthalmic Anesthesia Society Annual Meeting Presentation, Fall 2005
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