

Step-by-step guide to mastering skills with the Goldmann applanation tonometer

BY JOAN EFUA HANSON

Ophthalmology is a highly specialised field that requires proficiency in various diagnostic skills for numerous conditions. Entrants into ophthalmology at ST1 often possess minimal to no ophthalmic experience beyond what they learned in medical school. Consequently, they may face significant challenges during the initial months of specialty training. Hence, an additional effort and time is required during specialty training to fully master the diagnostic skills before getting accustomed to the field.

What complicates matters further is the fact that seasoned fellows and consultants, proficient in these diagnostic skills, may find it challenging to impart their expertise to trainees in a straightforward manner – they have performed these tasks countless and may struggle to recall how they initially learned them. Examples of such diagnostic skills include the use of indirect lenses, funduscopy, slit-lamp examination, and the Goldmann applanation tonometer (GAT).

The GAT remains the gold standard method for checking intraocular pressure (IOP) due to its high sensitivity and reliability [1]. However, GAT requires special operational skills and must be performed with the patient in an upright position. It cannot be used on scarred or irregular corneas and must always be used in conjunction with slit-lamps. Alternative methods for measuring IOP include the air puff tonometer, tonopen, and rebound tonometry (Icare). As the name suggests, GAT utilises the applanation method, which is based on Imbert Fick’s law [2]. This law states that “the pressure inside an ideal sphere is proportional to the force required to flatten (applanate) it at a constant area of 3.06mm.”

To initiate this procedure:

- The patient’s cornea is first anaesthetised using a local anaesthetic such as oxybuprocaine, and the tears are fluoresced using fluorescein dye.
- The tonometer’s biprisms are affixed to the feeder arm, and the illumination is adjusted to cobalt blue (Figure 1).
- The eyelids are gently retracted to expose the cornea, and the illumination system is angled appropriately with the applanation tonometer centrally positioned.
- Next, the joystick of the slit-lamp is pulled back, and the entire slit-lamp is advanced towards the cornea (Figure 1).
- When the biprisms are approximately 3–5mm away from the cornea, the medical practitioner looks through the eyepieces and gently pushes the joystick to bring the biprisms into contact with the cornea, without moving the entire slit-lamp.

Upon contact on the cornea, one or two semicircles of equal or unequal sizes become visible, depending on whether the central or peripheral cornea is touched (Figure 2). The objective is to adjust the knob and joystick until the two circles appear equal superiorly and inferiorly, with the inner edges of the semicircles just touching (Figure 2a). The number on the scale is then multiplied by 10 to obtain the accurate intraocular pressure in mmHg.

The scale ranges from 0 to 5 or 7 (equivalent to 0–50/70mmHg) depending on the model of the GAT apparatus, with each incremental reading representing 0.2 (2mmHg). After completing the measurement for the first eye, the slit-lamp is moved to the opposite eye, and the same process is repeated.

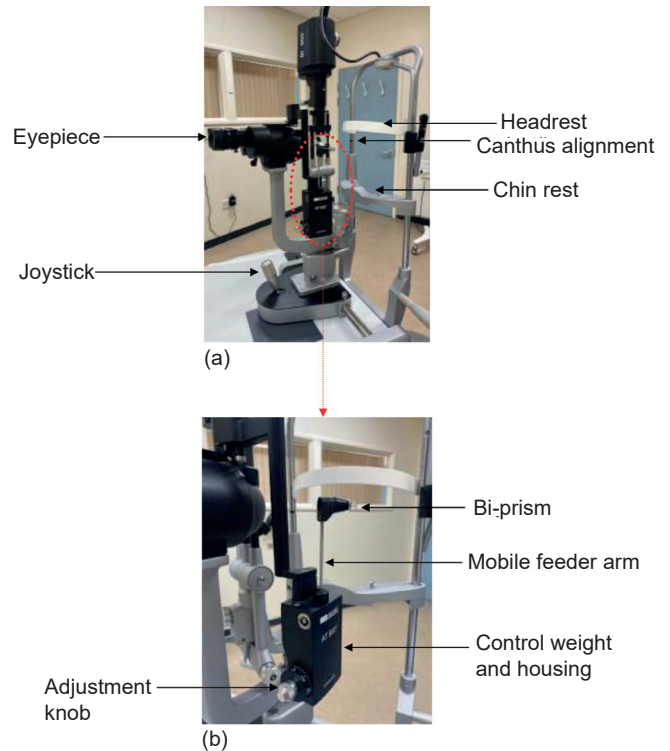


Figure 1: Showing the labelled parts of (a) slit-lamp Biomicroscope, and (b) GAT apparatus mounted on a slit-lamp.

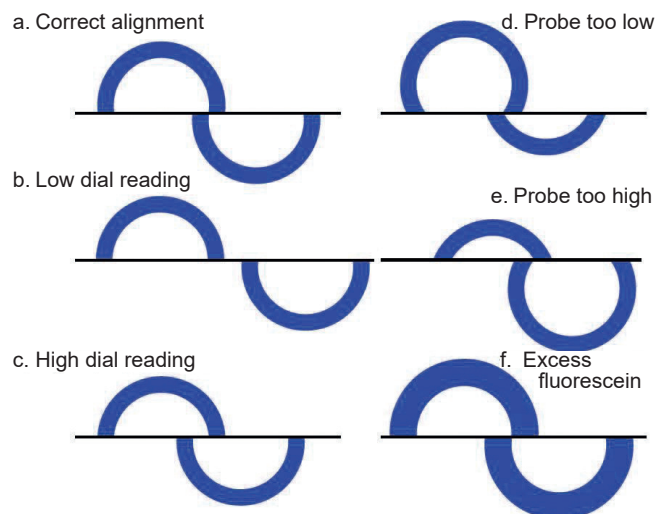


Figure 2: Showing various GAT mires Interpretation.

“Through consistent practice, lessons can be learned from each patient to continuously improve on the abilities with each attempt”

TOP TIPS

Here are some precautions to be taken to ensure accurate measurements for checking IOP:

1. Ensure that the patient's forehead and chin are properly positioned on the chin and forehead rests respectively, and the eye level marker (canthus alignment) is aligned with the lateral canthus of the eye.
2. Sit comfortably at the same level as the patient.
3. Ensure the patient is looking straight ahead during the measurement.
4. Avoid pressing on the globe to prevent artificially elevated IOP and false positive readings.
5. Confirm that the biprism, when viewed through the eyepiece, is horizontally divided.
6. Ensure the microscope is set to normal magnification.
7. Begin the examination with the scale / calibrated dial set to number 1 (10mmHg).

Solutions to GAT interpretation

- Correct alignment: aligns accurately for an accurate intraocular pressure reading.
- Low-dial reading: If the dial reading is low, adjust the calibrated dial on the tonometer backward to reach the accurate endpoint.
- High-dial reading: If the dial reading is high, adjust the calibrated dial on the tonometer forward to reach the endpoint.
- Probe too low: If the probe is positioned too low and not centrally, move it upwards to achieve proper alignment by turning the joystick clockwise.
- Probe too high: If the probe is positioned too high and not centrally, move it downwards to achieve proper alignment by turning the joystick counter-clockwise.
- Excess fluorescein: If there is excess fluorescein resulting in thick rings, wipe off some fluorescein or allow it to drain and repeat the measurement.

In conclusion, mastering ophthalmic diagnostic skills requires constant practice rather than a single attempt. It is essential to observe registrars and consultants, watch educational videos on YouTube platforms like 'Learn about eyes' [3] and most importantly, practise with every patient encounter. Through consistent practice, lessons can be learned from each patient to continuously improve on the abilities with each attempt.

References

1. Okafor KC, Brandt JD. Measuring intraocular pressure. *Curr Opin Ophthalmol* 2015;**26**(2):103–9.
2. Markiewitz HH. THE SO-CALLED IMBERT-FICK LAW. *JAMA Arch Ophthalmol* 1960;**64**(1):159.
3. Learn About Eyes. *YouTube*. <https://www.youtube.com/@learnabouteyes> [Link last accessed May 2024].

AUTHOR



Joan Efua Hanson,

Honorary Clinical Fellow, Birmingham and Midland Eye Centre, UK.

SECTION EDITOR



Ali Yagan,

Consultant Ophthalmic Surgeon, Neuro-ophthalmology and ocular motility, Manchester Royal Eye Hospital, UK.
ali.yagan@mft.nhs.uk

Declaration of competing interests: None declared.