Corneoplastique[™]: Art of vision surgery

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Corneoplastique incorporates the entire spectrum of Vision corrective surgery including Lasik, premium cataract surgery, corneal surgery, ocular surface surgery and the full range of anterior segment surgery itself in manipulating the optics of every eye towards unaided emmetropia to define each and every eye surgeon as a "Vision Corrective Surgeon". This concept of approaching each case individually and designing vision therewith enables surgeons to correct not only virgin eyes but also approach complex cases and complications with the goal of 20/20 vision. Armed with this holistic approach, eye surgeons can use minimally invasive, aesthetically pleasing and visually focused surgery in single or staged process aiming for each patient's Best Vision Potential (BVP) raising eye surgery itself then to an Art!

Key words: Lasik, corneal scars, corneoplastique, premium cataract surgery, refractive complications, radial keratotomy, pterygium, pinguecula, astigmatism, corneal scars



In our ongoing quest towards achieving a goal of "super vision", we continue to raise the bar on safety and predictability in effort to enable each and every patient to become a candidate for visual freedom!

In order to achieve such high aspirations, we must first believe that there are no limits to refractive surgery options, combinations, and stages if we are dedicated to reaching emmetropia in each and every case.

This is where I would like to introduce Corneoplastique[™] as a superspecialty in eye surgery involving minimally invasive, topical, brief, esthetically pleasing, and visually promising techniques encompassing the full spectrum of laser refractive, cataract, corneal, and entire anterior segment surgery chasing the goal of emmetropia not only in virgin refractive cases but also in complex and complicated cases leading them to best vision potential (BVP).

Therein, Corneoplastique[™] can involve the optical manipulation of intraocular elements by single or staged surgery to finally present the cornea as a "Vision Rehabilitative Platform".^[1-5]

This **art** of blending the full spectrum of ocular surface, corneal and intraocular surgery in a planned approach either before (to **prepare** the eye) or after eye surgery (to **repair** the eye) is the core function of this new superspecialty that keeps focusing on unaided emmetropia. Especially if you consider that these techniques are all brief, topical, and esthetically pleasing; and therefore a fond memory for the patient.

The goals of this superspecialty are:

1. Raising vision outcomes to beyond 20/20 in virgin eyes

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- Reversing practically any refractive complication (including laser-assisted *in situ* keratomileusis (LASIK), radial keratotomy (RK), multifocal implant, etc.) back to 20/20.
- 3. Turning patients who are not candidates (i.e., corneal scars, thin corneas, ectasias, irregular astigmatism, previous refractive surgeries like RK, etc.) into appropriate candidates.
- Applying the full spectrum of anterior corneal refractive and lenticular surgeries including multifocal lens implants along with infinite staged combinations to suit each eye individually.

In summary, practically any ocular situation (including virgin eyes with basic refractive errors like myopia, hyperopia, and astigmatism of all levels as well as status post cataract surgery, glaucoma surgery, retinal surgery, LASIK complications, corneal transplant, trauma, chemical burns, etc.) provided it has visual potential can be addressed to achieve its best unaided visual capacity.

As long as there is no intraocular pathology or disease, that is, retinal/neurological/uncontrolled glaucoma, etc.; there is no reason why we cannot stage towards a perfected visual outcome. The ability to help patients with refractive surgical complications/previous surgeries/chemical burns/trauma/etc., towards 20/20 vision is no longer out of reach in aspirations or outcomes.

This will raise the level of comfort for surgeons as well as patients because when you design surgery for an individual eye, you are planning for success "not just hoping for it".

As we shape this future, it is very important that we first understand the past; thus, we shall briefly review the origin of one of the most fundamental refractive surgical procedures, that is, keratomileusis, the underlying concepts of which to date remain unchanged, though technology has continued to evolve by leaps and bounds.

Lamellar refractive keratoplasty developed from the original concepts and work of Dr Jose Barraquer at his clinic in Bogota, Columbia.

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Drs Casimir Swinger, Lee Nordan, Leo Bores, and Richard Troutman later introduced these techniques to the United States. In the 1980s, Dr Luis Ruiz of Bogota, Columbia developed an automated geared keratome to raise this surgery to automated lamellar keratoplasty (ALK).

Keratomileusis and lamellar corneal surgeries can be combined into a modern day concept, in which laser refractive surgery is the keratomileusis and lamellar corneal manipulations become preparatory (to prepare for laser vision surgery) or reparatory (to repair laser vision surgery complications) in leading the patients to emmetropia (BVP).

Gulani Cardinal Rules for Refractive Surgeons

- There is no such question as "Am I a candidate?". Any patient who has a normal eye, with a normal optic nerve and brain, deserves perfect vision.
- 2. A "refractive surgeon" must know how to "refract", that is, garbage in-garbage out.
- I do not believe in differentiating between cornea, LASIK, and cataract surgeons. We are all "vision corrective" surgeons!
- 4. There is no case that is "complex". Every case is "unique". By this concept, there is also no case that is "routine".

Given these rules, every patient with a normal eye is a candidate for vision corrective surgery and it is our responsibility to take the time to customize a plan for their individual quest for improved vision to best vision potential (BVP), which could in many cases be beyond 20/20.

Towards this endeavor, I have suggested the 5S system which is an integral thought process leading to "demystifying" any presenting case scenario and "unfolding" a treatment plan.

The 5 S's stand for shape, sight, scar, site, and strength. The 5S system addresses the following questions in order to customize a treatment plan that provides optimum visual outcomes for the patient:

Sight: Is the patient correctable to 20/20 with glasses and/ or gas permeable contact lenses?

Site: Is the involvement central or peripheral?

- Scar: Is the cornea clear or opaque?
- Strength: Is the cornea thick or thin?

Shape: Is the curvature steep, flat, or is there astigmatism (regular/irregular)?

No matter what the etiology, the 5S system can determine the pathology and direct appropriate management.^[6,7]

This system can be applied to every refractive patient of myopia, hyperopia, and astigmatism seeking vision beyond 20/20, as well as to those patients who have faced complications as well as those that have undergone previous refractive surgery and seeking 20/20 vision once again.

This latter population of patients—those who have already undergone refractive surgery—consist of millions of people who constitute, in my opinion, an emerging "epidemic" in the world of ophthalmology, for which we need to prepare. Most of these patients can be corrected back to enjoy the excellent vision that they had once appreciated using modern technology. In a way, turning back the clock! One must make their diagnosis based on clinical evaluations along with surgical plan based on a logical approach to excellent vision.

For the case of previous refractive surgeries, a newlyproposed classification system is described below that may be beneficial in clarifying the subjective and objective principles to keep in mind when approaching such patients. This system may be universally applied in studying the surgery, clarifying the visual effects-complaint relationship, and planning steps in rehabilitation of vision for the patient.

The classification system may be divided into primary and secondary visual factors that both aid in the patient evaluation process and simplify a universal approach to diagnosis and surgical planning.^[8] Primary visual factors help evaluate the patient's symptoms, along with implied optical and refractive components. Secondary factors allow us to plan combination surgeries in our quest to address the eye for optimal optical performance.

Gulani Classification for Previous Refractive Surgery

Primary Visual Factors:

Quantitative:

- Decreased visual acuity (myopia, hyperopia, and astigmatism)
- Qualitative
- Irregular astigmatism
- Small optic zone
- Incisions

Secondary (Associated) Visual Factors:

- Presbyopia
- Cataracts
- Corneal scars
- Corneal instability (thin/ectasia/trampoline effect)

Once the above is determined, the plan simply unfolds in front of your eyes. The seemingly complex eye now provides the cornea as a platform of visual rehabilitation along with, if needed, associated surgeries like cataract, intraocular lens (IOL), etc. This is what I call "refractive surgery" to the rescue using the most accurate and elegant way to correct vision components in a calculated but least interventional manner.

Surface laser ablation in the form of excimer advanced surface ablation (ASA) or photorefractive keratectomy (PRK) is a very useful tool for correcting superficial irregularity,^[9] reshaping the cornea, as well as simultaneous scar peel with corneal shaping.^[10] In many a cases, double ablation ASA/ PRK can be used to smooth the surface and achieve refractive outcomes, including widening small or decentered optical zones of previous refractive surgeries.

The most important key factor is to determine whether just corneal shaping is required or whether the cornea needs to be rehabilitated prior to shaping.

Shape correction following most previous refractive surgeries can be achieved with the excimer laser, but architectural correction of the cornea, in the form of clearance (from scars) and strength (thickness) recovery (ectasia/ epikeratophakia) prior to shaping, can help prepare for the final laser vision surgery.^[11]

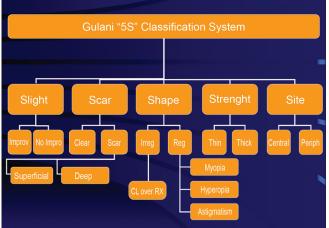
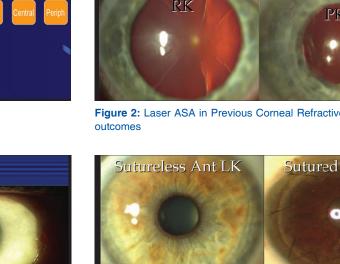


Figure 1: Gulani 5S System

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"Next Day" Post-op

Figure 3: Sutureless AMT surgery to "Next Day" Cosmetic Outcomes



Figure 5: Hand Lamellar Keratoplasty in Irregular/Extreme cases

In cases of corneal thickness or corneal instability, one needs to prepare the cornea by lamellar techniques (anterior or posterior) or inserts (INTACS, etc.)^[13,14] to then present it for reshaping using laser vision surgery.

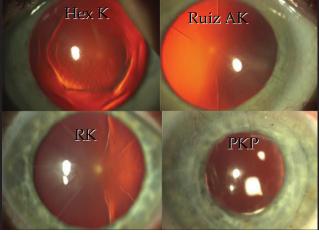
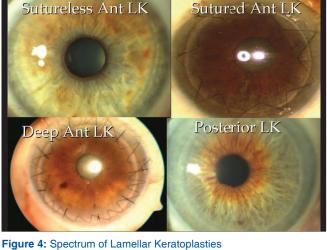


Figure 2: Laser ASA in Previous Corneal Refractive Surgery: 20/20



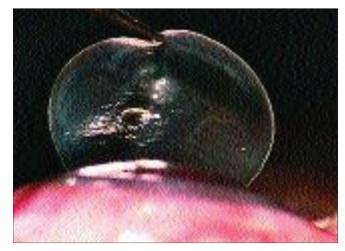


Figure 6: Automated Keratoplasty in Sutureless Cases

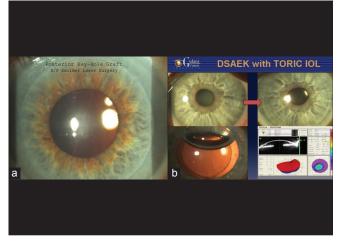


Figure 7: (a) DSAEK/DMEK with Laser ASA to 20/20. (b) DSAEK+ToricIOL= 20/20



Figure 8: Laser ASA after INTACS = 20/20 outcomes (CXL can be combined)



Figure 9: INTACS for Kconus, Lasik ectasia and ALK ectasia

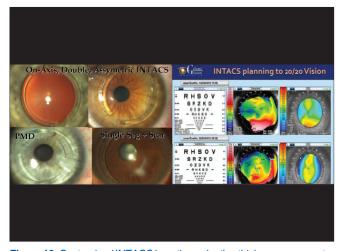


Figure 10: Customized INTACS insertions, depths, thickness, asymmetry to Emmetropia



Figure 11: (a) RK with Hex K, RK with Greene's Lasso suture, RK with Lasik with PiggyBack IOL: Laser ASA can be applied in such cases to 20/20 outcomes (b) RK with ReSTor IOL followed by Laser ASA to 20/20: 2-Staged approach

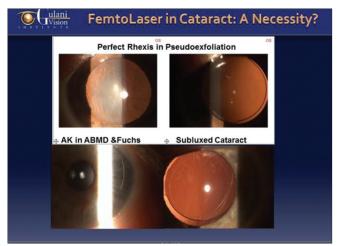


Figure 12: FemtoLaser in Cataract Surgery can be a necessity in special cases: Use Technology to your advantage

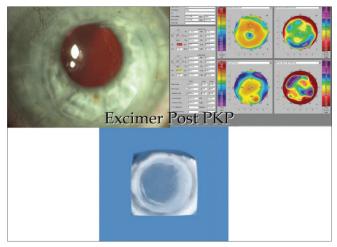


Figure 13: Laser ASA post PKP for High, Irregular Astigmatism



Figure 14: Supra-Bowman "On-Cornea" scars peeled and followed by Laser ASA (Notice camouflage topography with false, high, irregular astigmatism)



Figure 15: "In-Cornea" scars used as self-mask and Lasered through for refractive error (Notice True topography induced by in-cornea scar)

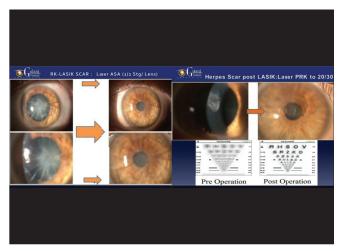


Figure 16: Laser ASA for Post RK and Post LASIK (Herpetic) scars: Clearance & Vision

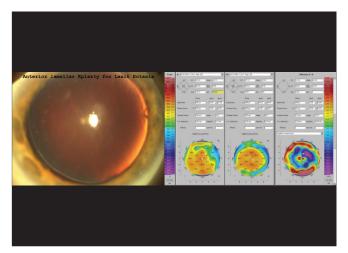


Figure 17: Laser ASA post Lamellar Transplant (for Lasik Ectasia with scar) to 20/20 Vision. Notice in adjacent topography, decreased keratometry and correction of high irregular astigmatism after Lamellar Keratoplasty (Stage I, prior to Laser Vision Surgery)

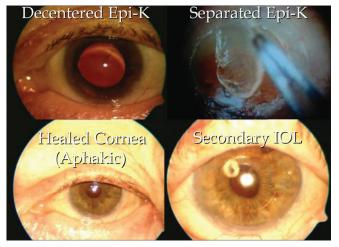


Figure 18: Decentered EpiKeratophakia with Aphakia corrected by removal of Epi-Lenticule followed by Secondary IOL: 20/20

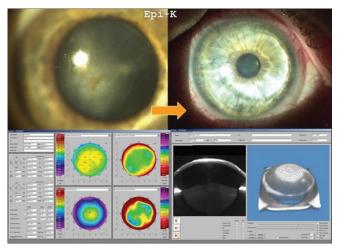


Figure 19: Laser ASA for Scarred, phakic EpiKeratophakia: Clearance & Vision

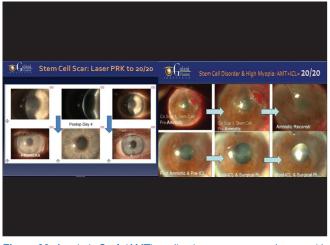


Figure 20: Amniotic Graft (AMT) application to prepare and stage with Refractive surgery. PROKERA [™] application with Laser ASA/PRK in one case and sutureless AMT followed by ICL in next case

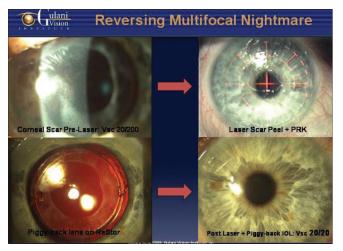


Figure 21: Multifocal IOL Nightmare reversed to 20/20: Corneoplastique Principles for Corneal Scar with ReSTor lens

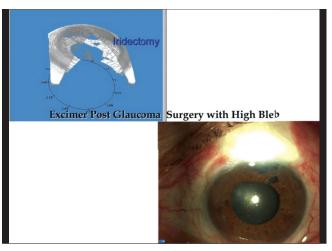


Figure 22: Laser ASA post High Astigmatism following a large Filtering Bleb in controlled Glaucoma



Figure 23: Laser ASA & Lens Implant Combinations: No Limits!

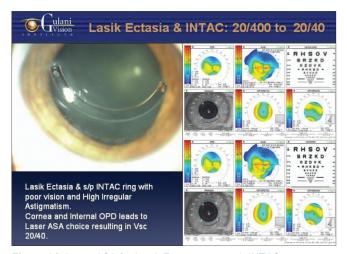


Figure 24: Laser ASA for Lasik Ectasia case with INTAC ring

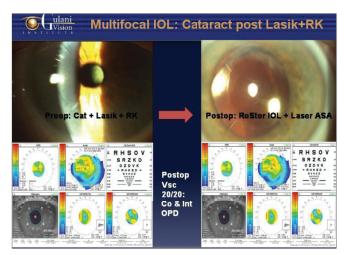


Figure 25: Multifocal Lens+ Laser ASA for case of RK+Lasik+Cataract: 20/20

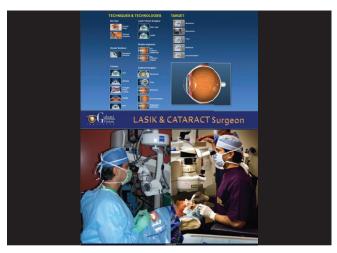


Figure 26: Vision a la Carte: Lasik, Cataract & Corneal skills: We are all "Vision Corrective Surgeons"- No Limits!



Figure 27: Gulani "Designing Vision" Concept and Template



Figure 29: Dr. Barraquer with Dr.Gulani

In cases of surface ocular surface irregularity, we can perform sutureless (glue) amniotic membrane surgery with excellent rehabilitation.^[15]



Figure 28: Dr. Lee Nordan travelled to observe Dr.Gulani raise Lamellar Keratoplasty to Corneoplastique™

If lamellar surgery is contemplated to rehabilitate the cornea, then we can plan for sutureless lamellar, anterior sutured (Barraquer anti-torque), deep anterior lamellar, or sutureless posterior lamellar surgeries^[16-20] and in this way prepare the cornea for future excimer surgery.

Technology to perform these can range from Handlamellar (Gulani Multi-dimensional Dissector) to automated microkeratomes and femtosecond lasers.

Lamellar corneal surgery is the original starting point for LASIK and also the end point for any complications arising from LASIK. This is why lamellar surgery is very important. Most complications associated with LASIK are related to the cornea.^[21,22]

The cornea can also be rehabilitated with INTACS in cases of post-LASIK ectasia. In such cases, too, one can still have the liberty of performing laser surgery (ASA) on top of the INTACS to address residual astigmatism.

Let's analyze this concept. The fact that the keratoconus or LASIK ectasia has been stabilized by the INTACS (acting like braces) allows us to shape the cornea just a little more (of course contact lenses and glasses are the noninterventional options here), since astigmatism removes the least amount of tissue when ablated with the excimer laser.

When considering intraocular surgery with lens implants, take full advantage of correcting not only the axial opacity (cataract) but also the refractive error with correct lens power calculation. The implants can range from phakic anterior and posterior implants to pseudophakic implants ranging from monofocal, toric, multifocal, accommodative, and piggyback.^[23-26]

Thus once again when fixing the eye, first address intraocular elements to literally manipulate the optics in preparation for laser corneal surgery (ASA). Each step of surgery in combined stages should prepare for the success of the next step towards final emmetropia.

Various modalities like collagen crosslinking,^[27-29] conductive keratoplasty,^[30] intracorneal implants, and glues can be used as adjuncts to most techniques.

This wide spectrum of applications is only limited by our logic and imagination, that is, responsible thinking and knowledge of anatomy, optics, and physiology, as they apply to selecting the most appropriate surgery or surgeries, should be kept in mind and effectively utilized synergistically to achieve an optimal visual outcome for the patient.

These very principles follow the concepts that have been integrated under the new system of CorneoplastiqueTM, wherein topical, brief, elegant, esthetically pleasing, minimally interventional surgeries are used singly, or in stages, to reach an ultimate goal of unaided emmetropia. Final fine tuning is performed using the excimer laser to further facilitate early rehabilitation and esthetically pleasing outcomes, in association with improved, uncorrected visual acuity.^[31-33]

This is in contrast to the more extensive standard surgical techniques like penetrating keratoplasties (PK), etc., wherein most cases the final unaided visual outcome, despite a long rehabilitation period, is less than optimal.^[34] Synergistically though, these standard surgeries, due to their proven track record, can always serve as a backup plan in selection of any of the above mentioned techniques.

Now that we understand the concept of thinking and approach, we know that where the patient had their surgery, what technology was used and who did it is irrelevant. What is important is the presentation of the patient and their complaints. Use technology to assist you in determining causative factors and a task-specific plan towards the goal of emmetropia/BVP.^[3540]

Listen to the patient and enumerate their concerns related to lifestyle limitations, occupations, or hobbies and direct your surgical approach with that goal. You will be amazed how well your patients will grasp these concepts and become a part of the team, dedicated to improvement of their vision. I call this the "Vision: A la Carte" approach.^[41,42]

This further bolsters the confidence that patients gain from you since they know you have thought through the whole process before embarking on the stages of improving one's vision rather than performing surgery and then piecing plans together as you go.

In cases of repairing complications, these patients do understand that their 20/20 will not be as good as a virgin refractive case, but given where they are coming from, and given what minimal trauma they will be going through with these techniques, it is a win-win for the team (patient and doctor).

Also, if the patient is already very happy at any intermediary stage (if you were planning combined stages), stop! The patient and their satisfaction is what we are addressing, not a topography chart.

This will open up the doors to millions of patients who are considered as "not a candidate". This will also open up the flood gates to patients with inadequate and complicated outcomes of refractive and premium vision surgery for a second chance at vision.

Our ability to understand the past will help us lead into the future and also navigate the waters of innovation so that not only can we endeavor to achieve supervision for our refractive patients of today, but we can also reshape the future of refractive patients from the past.

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