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IOL Power Calculation after Refractive Surgery: Where We Are?

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Currently cataract surgery with intraocular lens (IOL) implant is one of most commonly performed eye surgical procedures in USA [1]. So much time, indeed, passed from first IOL implants in human eye of Harold Ridely in 1949 and from their poor refractive results [2]: IOL implantation evolved from controversial to universally utilized [3,4] thanks to great improvements in materials adopted, implantation techniques, phacoemulsification introduction and improving refractive results [3]. Ophthalmologists have now extremely precise device to perform eye biometric measurements and many algorithms able to calculate the IOL power [5-8].

After the introduction of the excimer laser in the 1983, refractive surgery had a huge development and the number of patients who undergo this surgery, is still growing [9]. Many of these patients developed significant cataract, therefore underwent phacoemulsification and intraocular lens IOL implantation [10]. Obviously, these patients had a great visual expectation hindered by an IOL power calculation difficulties of an eye whose anatomy was modified by excimer laser [11]. The inaccuracy of IOL calculation in these cases, essentially, originates from three problems: first the inability to calculate the exact anterior corneal curvature by current available devices, second an invalidate keratometric index due to a change of relationship between the anterior and the posterior corneal surface, third an unreliable prediction of the effective lens position (ELP) calculated by the corneal curvature [11,12]. For every patient who undergo cataract surgery (CS) after refractive one and particularly after myopic procedures, many methods have been purposed in order to avoid poor refractive results (hyperopic refractions in most of cases), improving accuracy in IOL calculation [12-27]. Attention must be paid in the choice of the method used in these cases, because many new formulas have been purposed, their accuracy not always proved by a sufficient sample size [28].

Frequently used methods lay within two groups:1) methods that need patient's data before refractive surgery and 2) methods that do not need these ones.

Eiferman and Holladay described in the 1989 the Clinical History Method based on the knowledge of the preoperative keratometry, refraction and post refractive surgery refraction, this considered the gold standard for long time [29,30].

Recent papers suggest that methods not requiring the eye's parameters before refractive procedures provide equivalent or better refractive results than formulas that need them [31,32].

Rosa et al. have been the first to purpose a method, R-factor, to calculate corneal power in eyes previously treated with myopic corneal refractive surgery, unaware of clinical data before this kind of procedure [15]. Furthermore, variations to this method have been purposed in order to improve the precision of IOL calculations in eyes that could have had a regression of the refractive treatments [33].

Many methods have been recommended and several papers evaluated their accuracy [12-39]. The comparison between these studies very hard to achieve because of methods and data discrepancy [12-39]. This is the reason why Hoffer et al in 2015 [40] tried to standardize methods for studies assessing the accuracy of IOL power calculation.

Following these criteria [40] in further studies is absolutely suggested, in order to really compare accuracy of different methods.

To improve precision in IOL power algorithm calculation it might be erased the inner error in refraction due to limits in IOL manufacturing. Usually physicians try to calculate IOL for emmetropia but they choose to implant a power leading to a residual refractive error due to limitation related to IOL manifacturing. This refractive error is something that could bias a precise comparison and should be taken out from the analysis of IOL power supposed to provide effective emmetropia.

How Might it be Calculated?

Devices able to calculate IOL can provide the theoretical power for emmetropia even if it is hardly available from the ones produced by manufactures (0.5 D steps). How is it possible to obtain effective IOL power providing actual emmetropia? It is possible to do it back calculating it, knowing the power of the IOL implanted and the manifest stable refraction of the eye, taking in account that a variation of 1 D in the IOL power is providing a 0.7 D variation in the manifest refraction [7].

Example: if a +18D IOL was calculated for emmetropia and implanted in one eye and, after 1 month, refraction [measured as spherical equivalent] was -1.25 D, this means that IOL power has been overestimated. IOL providing precise emmetropia, in this case, can be calculated adding the 70% of the refraction to the implanted IOL= +18 D + [-1.25 D *0.7]= 17.125D.

To compare IOL power to reach precise emmetropia, might be a step forward to standardized analysis for these studies.

References

1. Wiliams A, Sloan F, Lee P. Longitudinal rates of cataract surgery. Arch Ophthalmol. 2006; 124: 1308-1314.
2. Ridley H. Intraocular acrylic lenses. A recent development in the surgery of cataract. Br J Ophthalmol. 1952; 36: 113–122.
3. Hoffer KJ. Pre-operative cataract evaluation: intraocular lens power calculation. Int Ophth Clin. 1982; 22: 37–75.

4. Hillman JS. Intraocular lens power calculation for emmetropia: a clinical study. Br J Ophthalmol. 1982; 66: 53–56.
5. Behnding A, Montan P, Stenevi U, Kugelberg M, Zetterström C, et al. Aiming for emmetropia after cataract surgery: Swedish National Cataract Register study. J Cataract Refract Surg 2012; 38: 1181-1186.
6. Khor WB, Afshari NA. The role of presbiopia-correcting intraocular lenses after in situ Keratomileusis. Curr Opin Ophthalmol. 2013; 24: 35-40.
7. Olsen T. Improved accuracy of intraocular lens power calculation with Zeiss IOL Master. Acta Ophthalmol Scand. 2007; 85: 84-87.
8. Alio JL, Abdelghany AA, Buenaga RF. Management of residual refractive error after cataract surgery. Curr. Opin.Ophthalmol. 2014; 25: 291-297.
9. Aristeidou A, Taniguchi EV, Tsatsos M, Muller R, McAlinden C, et al.The evolution of corneal and refractive surgery with the femtosecond laser. Eye Vis. 2015; 14; 2: 12.
10. Klein BE, Klein R, Lee KE, Gangnon RE. Incidence of age-related cataract over a 15-year interval; the Beaver Dam Eye Study. Ophthalmology. 2008; 115: 477–482.
11. Koch DD. New options for IOL calculations after refractive surgery. J Cataract Refract Surg. 2006; 32: 371–372.
12. Hoffer KJ. Intraocular lens power calculation after previous laser refractive surgery. J Cataract Refract Surg. 2009; 35: 759-765.
13. Haigis W. Intraocular lens calculation after refractive surgery for myopia: Haigis L formula. J Cataract Refract Surg. 2008; 34: 1658-1663.
14. Aramberri J. Intraocular lens power calculation after corneal refractive surgery: double-K method. J Cataract Refract Surg. 2003; 29: 2063–2068.
15. Feiz V, Mannis MJ, Garcia-Ferrer F, Kandavel G, Darlington JK, et al. Intraocular lens power calculation after laser in situ keratomileusis for myopia and hyperopia; a standardized approach. Cornea. 2001; 20: 792–797.
16. Rosa N, Capasso L, Romano A. A new method of calculating intraocular lens power after photorefractive keratectomy. J Refract Surg. 2002; 18: 720–724.
17. Jarade EF, Tabbara KF. New formula for calculating intraocular lens power after laser in situ keratomileusis. J Cataract Refract Surg. 2004; 30: 1711–1715.
18. Latkany RA, Chokshi AR, Speaker MG, Abramson J, Soloway BD, et al. Intraocular lens calculations after refractive surgery. J Cataract Refract Surg. 2005; 31: 562–570.
19. Masket S, Masket SE. Simple regression formula for intraocular lens power adjustment in eyes requiring cataract surgery after excimer laser photoablation. J Cataract Refract Surg. 2006; 32: 430–434.
20. Camellin M, Calossi A. A new formula for intraocular lens power calculation after refractive corneal surgery. J Refract Surg. 2006; 22: 187–199.
21. Kim JH, Lee DH, Joo CK. Measuring corneal power for intraocular lens power calculation after refractive surgery; comparison of methods. J Cataract Refract Surg. 2002; 28: 1932–1938.
22. Ferrara G, Cennamo G, Marotta G, Loffredo E. New formula to calculate corneal power after refractive surgery. J Refract Surg. 2004; 20: 465–471.
23. Sonego-Krone S, Lopez-Moreno G, Beaujon-Balbi OV, Arce CG, Schor P, et al. Direct method to measure the power of the central cornea after myopic laser in situ keratomileusis. Arch Ophthalmol. 2004; 122: 159–166.
24. Ianchulev T, Salz J, Hoffer K, Albini T, Hsu H, et al. Intraoperative optical refractive biometry for intraocular lens power estimation without axial length and keratometry measurements. J Cataract Refract Surg. 2005; 31: 1530–1536.
25. Cheng ACK, Lam DSC. Keratometry for intraocular lens power calculation using Orbscan II in eyes with laser in situ keratomileusis. J Refract Surg. 2005; 21: 365–368.
26. Razmjoo H, Peyman A, Kashfi A, Peyman M, Dehghani A. A regression model for correcting intraocular lens power after refractive surgery independent of preoperative data. Eur J Ophthalmol 2006; 16: 525–529.
27. Mackool RJ, Ko W, Mackool R. Intraocular lens power calculation after laser in situ keratomileusis: aphakic refraction technique. J Cataract Refract Surg. 2006; 32: 435–437.
28. Borasio E, Stevens J, Smith GT. Estimation of true corneal power after keratorefractive surgery in eyes requiring cataract surgery: BESSt formula. J Cataract Refract Surg. 2006; 32: 2004–2014.
29. De Bernardo M, Capasso L, Caliendo L, Paolercio F, Rosa N. IOL Power Calculation after Corneal Refractive Surgery. BioMed Research International. 2014; 2014: 658350.
30. Eiferman RC. Corneal wound healing and the future of refractive surgery, Refractive and Corneal Surgery.

1989; 2: 73–74.

31. Holladay JT. Consultations in refractive surgery Refractive Corneal surgery. 1989; 5: 203.
32. McCarthy M, Gavanski GM, Paton KE, Holland SP. Intraocular lens power calculations after myopic laser refractive surgery: a comparison of methods in 173 eyes. Ophthalmology. 2011; 118: 940–944.
33. Wang L, Hill WE, Koch DD. Evaluation of intraocular lens power prediction methods using the American Society of Cataract and Refractive Surgeons Post-Keratorefractive Intraocular Lens Power Calculator. J Cataract Refract Surg. 2010; 36: 1466-1473.
34. Rosa N, De Bernardo M, Borrelli M, Lanza M. New factor to improve reliability of the clinical history method for intraocular lens power calculation after refractive surgery Journal of Cataract and Refractive Surgery. 2010; 36: 2123–2128.
35. Abulafia A, Hill WE, Koch DD, Wang L, Barrett GD. Accuracy of the Barrett True-K formula for intraocular lens power prediction after laser in situ keratomileusis or photorefractive keratectomy for myopia. J Cataract Refract Surg. 2016; 42: 363-369.
36. Shammas HJ, Shammas MC. No-history method of intraocular lens power calculation for cataract surgery aftermyopic laser in situ keratomileusis. J Cataract Refract Surg. 2007; 1: 31–36.
37. Murdoch IE, Morris SS, Cousens SN. People and eyes: statistical approaches in ophthalmology. Br J Ophthalmol. 1998; 82: 971-973
38. Rosa N, Capasso L, Lanza M, Iaccarino G, Romano A. Reliability of a new correcting factor in calculating intraocular lens power after refractive corneal surgery. J Cataract Refract Surg. 2005; 5: 1020–1024.
39. Shammas HJ, Shammas MC, Garabet A, Kim JH, Shammas A, et al. Correcting the corneal power measurements for intraocular lens power calculations after myopic laser in situ keratomileusis. Am J Ophthalmol. 2003; 3: 426–432.
40. Haigis W. IOL-Berechnung nach refraktiver Hornhautchirurgie mit aktuellen Messwerten. Ophthalmo-Chirurgie. 2006; 18: 27–30.
41. Hoffer KJ, Aramberri J, Haigis W, Olsen T, Savini G, et al. Protocols for studies of intraocular lens formula accuracy. Am J Ophthalmol. 2015; 160: 403-405.