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Validation of Najjar-Awwad cataract surgery risk score for resident phacoemulsification surgery

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Abstract

PURPOSE—To validate the Najjar-Awwad cataract surgery risk score for residents, which has been proposed to predict surgical complexity and risk.

SETTING—Two urban public county hospitals.

DESIGN—Case series.

METHODS—Phacoemulsification cataract surgeries performed by residents between January 2005 and April 2008 were retrospectively reviewed. The cataract risk score was calculated retrospectively. Intraoperative complications included posterior and anterior capsular tears, vitreous prolapse, dropped nucleus, and conversion to manual extracapsular cataract extraction.

RESULTS—Of the cases performed by 33 residents, 1833 met the inclusion criteria. There were 120 complications (6.5%); the rate of complications involving vitreous prolapse or loss (including dropped nucleus) was 3.2%. Significant risk factors in the risk score associated with intraoperative complications were dense nuclear sclerosis (odds ratio [OR], 2.08; 95% confidence interval [CI], 1.32–3.26; $P = .004$) and poor red reflex (OR, 2.10; 95% CI, 1.45–3.06; $P = .00007$). Cataract risk scores ranged from 3 to 16. The score was less than 5 in 85 cases (4.6%) and less than 7 in 885 cases (48.3%). The OR for complications increased significantly when the risk score was higher than 6 (OR, 2.11; 95% CI, 1.42–3.14; $P = .0002$).

CONCLUSIONS—Although the Najjar-Awwad cataract surgery risk score can be used to predict intraoperative complications at the time of cataract surgery, the complication rate did not significantly increase until the score reached 7. There were few cases with scores lower than 5 in these county hospital populations. Beginning surgeons should be given cases with a risk score of less than 7.

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Experience is key in mastering any skill or procedure, and phacoemulsification is no exception. Surgeons with less experience have significantly higher rates of posterior capsule

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rupture than more experienced surgeons.^{1–3} The resident phacoemulsification learning curve has been described. Randleman et al.⁴ found that intraoperative complications significantly decreased after the first 80 cases, with the rate approaching that of experienced surgeons after 160 cases. Rogers et al.⁵ found a significantly lower intraoperative complication rate after the first 60 cases. Although good visual outcomes can be achieved after vitreous loss and other complications,⁶ less complex cases can be chosen for earlier surgeries to decrease complications during the beginner phase of learning.

Najjar and Awwad⁷ published a cataract surgery risk score to prospectively assess the complexity of phacoemulsification for beginning resident surgeons (Figure 1). However, to our knowledge, this score has not been validated. This study assessed the validity of the risk score.

PATIENTS AND METHODS

The Institutional Review Board, University of Texas Southwestern Medical Center, approved this study. All phacoemulsification cataract surgeries performed by second- or third-year ophthalmology residents at Parkland Memorial Hospital or John Peter Smith Hospital between January 2005 and April 2008 were retrospectively reviewed. Parkland is the public county hospital for Dallas County, and John Peter Smith is the public county hospital for the adjacent Tarrant County. During this time, preoperative evaluation of the risk factors described by Najjar and Awwad⁷ were routinely recorded. All phacoemulsification procedures were performed using the Infinity Lens Removal System (Alcon, Inc.). The primary intraocular lens (IOL) used was a single-piece hydrophobic acrylic posterior chamber model. Dye (indocyanine green or trypan blue) was available for use in cases with a poor red reflex.

At John Peter Smith Hospital, second- and third-year residents operate as the primary surgeon using a divide-and-conquer technique. The second-year resident performs most cases, with the third-year resident performing only the most complex cases. At Parkland Memorial Hospital, only third-year residents act as the primary surgeon for cataract extraction. The divide-and-conquer technique predominates, although horizontal chopping is also used at the discretion of the attending physician. The choice of anesthesia used is also at the discretion of the attending physician.

Cases with incomplete documentation were excluded, as were cases of traumatic, congenital, and polar cataract and lenses with dislocation or phacodonesis noted preoperatively.⁷ The Najjar-Awwad cataract risk score was calculated for included cases. Intraoperative complications recorded included posterior and anterior capsule tears, vitreous prolapse, dropped nucleus, and conversion to manual extracapsular cataract extraction (ECCE). Each risk factor was analyzed for association with a complication and in addition to odds ratios (OR), *P* values were calculated using the chi-square test.

RESULTS

Of the 1833 cases performed by 33 residents that met the inclusion criteria, 1273 were performed at Parkland and 560 at John Peter Smith. The mean patient age was 63 years $\pm$ 11

(SD) (range 20 to 92 years); 1135 surgeries (62%) were performed in women and 939 cases (51%) in right eyes. Racial distribution was Latino, 715 cases (39%); white, 465 cases (25%); black, 482 cases (26%); and other, 171 cases (9%). Anesthesia was local in 1652 cases (90%), general in 161 cases (9%), and topical in 20 cases (1%).

Table 1 shows intraoperative complications, of which there were 120 (6.5%) overall. Only 59 cases (3.2%) had complications involving vitreous prolapse or loss (including dropped nucleus). Table 2 shows the OR for complications for each risk factor in the Najjar-Awwad cataract risk score. Significant preoperative risk factors for intraoperative complications were cataract density ($P = .004$) and poor red reflex ($P = .00007$).

Fewer than 5.0% of cases (85 [4.6%]) had a calculated cataract risk score lower than 5 (Figure 2). Table 3 shows the OR for each cataract risk score, comparing cases at or above a level with cases scoring below the level. The most significant level was in cases with a risk score of 7 or higher.

DISCUSSION

This study validated the utility of the Najjar-Awwad cataract surgery risk score.⁷ The 3.2% rate of vitreous prolapse/loss in the study compares favorably with the rate in other published studies of resident cataract surgery. Although older studies report vitreous loss rates ranging from 1.8% to 14.7%,^{6,8–19} studies in the past 5 years report a range of 3.1% to 6.9% (Table 4).^{1,4,20–25}

In addition to including posterior capsule tears, vitreous prolapse/loss, dropped nucleus, and conversion to manual ECCE, we defined intraoperative complications to include anterior capsule tears because a noncontinuous capsulorhexis would prevent implantation of a single-piece hydrophobic acrylic IOL, placing the patient at higher risk for postoperative IOL decentration. Our total intraoperative complication rate was therefore 6.5%, and this also compares favorably with other studies with broader definitions of intraoperative complications. Using a similar definition (by excluding iris trauma and iris prolapse from reported results), Lee et al.²⁴ found intraoperative complications in 21.7% of resident cases and Rutar et al.²³ in 9.7%. These study populations were not strictly similar to the population in the current study, which excluded traumatic, congenital, and polar cataracts and lenses with dislocation or phacodonesis noted preoperatively. This is because the Najjar-Awwad cataract risk score assumes that such cases would not be given to beginning surgeons.

In the current study, dense nuclear sclerosis and a poor red reflex possibly requiring the use of capsule staining with dye were significantly associated with complications, with a doubling of the OR. Dense nuclear sclerosis was also significantly associated with complications (OR, 18.9) in Rutar et al.'s²³ study of 320 patients having resident-performed phacoemulsification. In addition to dense nuclear sclerosis, white cataracts, use of capsule dye staining, and miosis were significantly associated with posterior capsule complications in the Swedish Capsule Rupture Study.³ The Cataract National Dataset electronic multicenter audit of 55 567 operations in the United Kingdom found a significant

association of posterior capsule rupture and vitreous loss with factors including increasing age, male sex, presence of glaucoma, diabetic retinopathy, brunescant/white cataract, poor view of the fundus, small pupil size, axial length of 26.0 mm or longer, and inability to lie flat.²⁶

Najjar and Awwad⁷ originally recommended that cases with risk scores lower than 5 be given to beginning surgeons; however, only 4.6% of cases in the current study had such a score. In addition, we found that complications were not significantly increased until the risk score was 7 or higher. Almost half the cases (48.3%) in this study had a risk score lower than 7. Although the Najjar-Awwad cataract surgery risk score can be used to predict intraoperative complications, we recommend that beginning surgeons be assigned cases with a risk score lower than 7. Most factors in the Najjar-Awwad cataract risk score are intrinsic to the patient's examination and history; however, the surgeon controls the choice of anesthesia. Programs having difficulty finding a sufficient number of cases for beginning surgeons might consider using local or even general anesthesia, when appropriate, to increase the pool of appropriate cases.

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References

1. Tayanithi P, Pungpapong K, Siramput P. Vitreous loss during phacoemulsification learning curve performed by third-year residents. *J Med Assoc Thai*. 2005; 88(suppl 9):S89–S93.
2. Johnston RL, Taylor H, Smith R, Sparrow JM. The Cataract National Dataset electronic multicentre audit of 55,567 operations: variation in posterior capsule rupture rates between surgeons. *Eye*. 2010; 24:888–893. [PubMed: 19680280]
3. Artzén D, Lundström M, Behndig A, Stenevi U, Lydahl E, Montan P. Capsule complication during cataract surgery: case-control study of preoperative and intraoperative risk factors; Swedish Capsule Rupture Study Group report 2. *J Cataract Refract Surg*. 2009; 35:1688–1693. [PubMed: 19781460]

4. Randleman JB, Wolfe JD, Woodward M, Lynn MJ, Cherwek DH, Srivastava SK. The resident surgeon phacoemulsification learning curve. *Arch Ophthalmol*. 2007; 125:1215–1219. Available at: <http://archophth.ama-assn.org/cgi/reprint/125/9/1215>. Accessed June 8, 2010. [PubMed: 17846361]
5. Rogers GM, Oetting TA, Lee AG, Grignon C, Greenlee E, Johnson AT, Beaver HA, Carter K. Impact of a structured surgical curriculum on ophthalmic resident cataract surgery rates. *J Cataract Refract Surg*. 2009; 35:1956–1960. [PubMed: 19878829]
6. Blomquist PH, Rugwani RM. Visual outcomes after vitreous loss during cataract surgery performed by residents. *J Cataract Refract Surg*. 2002; 28:847–852. [PubMed: 11978467]
7. Najjar DM, Awwad ST. Cataract surgery risk score for residents and beginning surgeons. *J Cataract Refract Surg*. 2003; 29:2035–2036.
8. Cruz OA, Wallace GW, Gay CA, Matoba AY, Koch DD. Visual results and complications of phacoemulsification with intraocular lens implantation performed by ophthalmology residents. *Ophthalmology*. 1992; 99:448–452. [PubMed: 1565459]
9. Allison RW, Metrikin DC, Fante RG. Incidence of vitreous loss among third-year residents performing phacoemulsification. *Ophthalmology*. 1992; 99:726–730. [PubMed: 1594218]
10. Noecker RJ, Allison RW, Snyder RW. Resident phacoemulsification experience using the in situ nuclear fracture technique. *Ophthalmic Surg*. 1994; 25:216–221. [PubMed: 8015772]
11. Tabandeh H, Smeets B, Teimory M, Seward H. Learning phacoemulsification: the surgeon-in-training. *Eye*. 1994; 8:475–477. [PubMed: 7821478]
12. Tarbet KJ, Mamalis N, Theurer J, Jones BD, Olson RJ. Complications and results of phacoemulsification performed by residents. *J Cataract Refract Surg*. 1995; 21:661–665. [PubMed: 8551443]
13. Thomas R, Naveen S, Jacob A, Braganza A. Visual outcome and complications of residents learning phacoemulsification. *Indian J Ophthalmol*. 1997; 45:215–219. Available at: <http://www.ijo.in/text.asp?1997/45/4/215/14998>. Accessed June 8, 2010. [PubMed: 9567016]
14. Corey RP, Olson RJ. Surgical outcomes of cataract extractions performed by residents using phacoemulsification. *J Cataract Refract Surg*. 1998; 24:66–72. [PubMed: 9494901]
15. Prasad S. Phacoemulsification learning curve: experience of two junior trainee ophthalmologists. *J Cataract Refract Surg*. 1998; 24:73–77. [PubMed: 9494902]
16. Albanis CV, Dwyer MA, Ernest JT. Outcomes of extracapsular cataract extraction and phacoemulsification performed in a university training program. *Ophthalmic Surg Lasers*. 1998; 29:643–648. [PubMed: 9715489]
17. Badoza DA, Jure T, Zunino LA, Argento CJ. State-of-the-art phacoemulsification performed by residents in Buenos Aires, Argentina. *J Cataract Refract Surg*. 1999; 25:1651–1655. [PubMed: 10609212]
18. Quillen DA, Phipps SJ. Visual outcomes and incidence of vitreous loss for residents performing phacoemulsification without prior planned extracapsular cataract extraction experience. *Am J Ophthalmol*. 2003; 135:732–733. [PubMed: 12719096]
19. Randleman JB, Srivastava SK, Aaron MM. Phacoemulsification with topical anesthesia performed by resident surgeons. *J Cataract Refract Surg*. 2004; 30:149–154. [PubMed: 14967283]
20. Blomquist PH, Pluenneke AC. Decrease in complications during cataract surgery with the use of a silicone-tipped irrigation/aspiration instrument. *J Cataract Refract Surg*. 2005; 31:1194–1197. [PubMed: 16039497]
21. Ünal M, Yücel , Sarıcı A, Artunay Ö, Devrano lu K, Akar Y, Altın M. Phacoemulsification with topical anesthesia: resident experience. *J Cataract Refract Surg*. 2006; 32:1361–1365. [PubMed: 16863976]
22. Bhagat N, Nissirios N, Potdevin L, Chung J, Lama P, Zarbin MA, Fechtner R, Guo S, Chu D, Langer P. Complications in resident-performed phacoemulsification cataract surgery at New Jersey Medical School. *Br J Ophthalmol*. 2007; 91:1315–1317. [PubMed: 17431020]
23. Rutar T, Porco TC, Naseri A. Risk factors for intraoperative complications in resident-performed phacoemulsification surgery. *Ophthalmology*. 2009; 116:431–436. [PubMed: 19167084]
24. Lee J-S, Hou C-H, Yang M-L, Kuo JZ-C, Lin K-K. A different approach to assess resident phacoemulsification learning curve: analysis of both completion and complication rates. *Eye*. 2009; 23:683–687. [PubMed: 18239676]

25. Kim JY, Ali R, Cremers SL, Yun S-C, Henderson BA. Incidence of intraoperative complications in cataract surgery performed by left-handed residents. *J Cataract Refract Surg.* 2009; 35:1019–1025. [PubMed: 19465287]
26. Narendran N, Jaycock P, Johnston RL, Taylor H, Adams M, Tole DM, Asaria RH, Galloway P, Sparrow JM. The Cataract National Dataset electronic multicentre audit of 55 567 operations: risk stratification for posterior capsule rupture and vitreous loss. *Eye.* 2009; 23:31–37. [PubMed: 18327164]

BASIC SCORE		SCORE
1. Age of the Patient (y)		
<50		1
50–65		2
66–80		3
>80		4
2. Type of Anesthesia		
General		0
Local		2
Topical		4
3. Cataract Density		
NS	ASC/PSC	
Moderate	Mild–moderate	1
Mild	Mild–moderate	2
Moderate	Dense	2
Mild	Dense	3
Dense	Dense	4
ADDITIONAL POINTS		
4. Frontal bossing/sunken globes		1
5. High hyperopia/myopia		1
6. History of glaucoma, uveitis, or intraocular surgery		1
7. History of complications in the fellow eye		1
8. Shallow anterior chamber		1
9. Corneal cloudiness		1
10. Poor red reflex (possible use of capsule stain)		1
11. Pseudoexfoliation		3
12. Poor pupil dilation		3
TOTAL SCORE		25

ASC = anterior subcapsular opacities; NS = nuclear sclerosis;
PSC = posterior subcapsular opacities

Figure 1.
Cataract risk score proposed by Najjar and Awwad.⁷

Figure 2.
Distribution of cases by cataract surgery risk score.

Table 1

Intraoperative complications in 1833 phacoemulsification cataract surgeries.

Complication	Number (%)
Posterior capsule tear with vitreous prolapse	48 (2.6)
Posterior capsule tear with intact anterior hyaloid face	15 (0.8)
Zonular dehiscence with vitreous prolapse	8 (0.4)
Zonular dehiscence without vitreous prolapse	6 (0.3)
Dropped nucleus	8 (0.4)
Anterior capsule tear	29 (1.6)
Could not complete CCC	14 (0.8)
Phacoemulsification wound burn	0
Conversion to manual ECCE	8 (0.4)
Any complication *	120 (6.5)

CCC = continuous curvilinear capsulorhexis; ECCE = extracapsular cataract extraction

* Although some cases had multiple complications, the total number of unique cases with complications was 120

Table 2

Odds ratios for each risk factor in the Najjar-Awwad cataract risk score.

Risk Factor	OR	95% Confidence Limit	
		Lower	Upper
Age (y)			
50–65 vs <50	0.90	0.49	1.64
65–80 vs <50	1.05	0.56	1.96
80 vs <50	1.08	0.42	2.76
Anesthesia			
Local vs general	0.95	0.50	1.81
Topical vs general	0.72	0.09	5.87
Cataract density			
Grade 2 vs grade 1	0.96	0.60	1.53
Grade 3 vs grade 1	0.74	0.23	2.44
Grade 4 vs grade 1	2.08	1.32	3.26
Frontal bossing/sunken globes	0.27	0.04	1.96
High hyperopia/myopia	0.80	0.49	1.30
History of glaucoma, uveitis, or previous intraocular surgery	1.35	0.84	2.17
History of complications in fellow eye	1.90	0.85	4.28
Shallow anterior chamber	1.45	0.57	3.70
Corneal cloudiness	1.17	0.42	3.30
Poor red reflex (possible use of capsule stain)	2.10	1.45	3.06
Pseudoexfoliation	1.10	0.14	8.47
Poor pupil dilation	1.65	0.64	4.24

OR = odds ratio

Table 3

Odds ratios for level of cataract risk score.

OR	Cataract Risk Score	95% Confidence Limit		P Value
		Lower	Upper	
>3	1.69	0.23	12.61	.60
>4	1.13	0.45	2.84	.80
>5	1.16	0.71	1.88	.55
>6	2.11	1.42	3.14	.0002
>7	1.87	1.28	2.72	.0009
>8	1.61	1.06	2.46	.03
>9	1.94	1.18	3.18	.008
>10	2.06	1.00	4.24	.05

OR = odds ratio

Table 4

Recent studies reporting vitreous prolapse and vitreous loss rates for phacoemulsification performed by residents.

Study*	Year	Patients (n)	Vitreous Prolapse/Loss Rate (%)
Blomquist ²⁰	2005	1877	4.2
Tayanithi ¹	2005	404	6.9
Ünal ²¹	2006	296	6.4
Randleman ⁴	2007	680	3.4
Bhagat ²²	2007	719	5.4
Rutar ²³	2009	320	3.1
Lee ²⁴	2009	226	4.9
Kim ²⁵	2009	1730	6.5

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