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Diode laser transscleral retinopexy in rhegmatogenous retinal detachment surgery

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PURPOSE. *To evaluate the safety and efficacy of transscleral diode laser for retinopexy in rhegmatogenous retinal detachment surgery.*
METHODS. *Conventional retinal detachment surgery with transscleral diode laser retinopexy was performed on 52 eyes of 52 patients (22 female, 30 male), aged from 12 to 74 years (mean 51 + 4.1).*
RESULTS. *Of the 52 eyes 36 (69%) were reattached in a single operation and adequate chorioretinal scars were achieved in 34 of them. Additional transpupillary laser photocoagulation was performed in two cases in the postoperative period. Retinal re-attachment was achieved with exoplant revision and transscleral laser retinopexy in six cases (12%). Ten cases (19%) with severe PVR were reattached with vitreoretinal surgery.*
CONCLUSIONS. *Transscleral diode laser retinopexy was an effective and safe method, with accurate lesion location, concurrent permanent laser marks on the retina, and easy transmission through the extraocular muscles and solid buckling elements. Minor complications were minimized by gaining experience with the technique. (Eur J Ophthalmol 2001; 11: 356-60)*

KEY WORDS. *Diode laser, Photocoagulation, Retinal detachment*

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INTRODUCTION

Gonin was the first to note that a retinal tear leads to retinal detachment, around the beginning of the 20th century (1). In retinal detachment surgery, diathermy, cryopexy and transpupillary or transvitreal (endo) laser sources are used to create an adhesion between the sensorial retina and retinal pigment epithelium by inducing scar tissue formation around the retinal tear (2-7). The semi-conducting diode laser is as efficient as the transpupillary argon laser, especially in retinal vascular disease (8-10). Application of infrared wavelength lasers over the external ocular surface reaches the choroid and retina, with negligible absorption of the diode laser by the sclera and conjunctiva (11-13).

In this study, we evaluated the results of transscleral diopexy in retinal detachment surgery, which we have been using for over a year in our department.

MATERIALS AND METHODS

Conventional retinal detachment surgery with transscleral diode laser retinopexy was performed on 52 eyes of 52 patients (22 female, 30 male) with a diopexy probe and Oculight SLX photocoagulator unit, manufactured by Iris Medical Corp. The patients ranged in age from 12 to 74 years (mean 51 ± 4.1). Four had retinal dialysis due to trauma, 48 had primary rhegmatogenous retinal detachment. Two of the patients with retinal dialysis had the lesion in the inferior quadrant and were 12 and 14 years old. The preoperative and postoperative proliferative vitreoretinopathy

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(PVR) grades of the patients are given according to the Retina Society Classification (14) in Table I: half the patients had PVR grade C1 and above.

We performed a scleral buckling procedure on 49 patients under subtenon anesthesia and on three under general anesthesia (Tab. II). The diode laser treatment was started as 1500 msec exposure duration and 750-1250 mW power, depending on the patient's fundus pigmentation. Retinopexy during surgery was adequate when we obtained 1 to 3 rows of gray retinal reaction surrounding the tears or dialyses and attachment of the retina after draining subretinal fluid through the sclerotomy, as needed. We used intravitreal 20% SF6 (sulfur hexafluoride) gas in 30 cases and intravitreal air in six cases as tamponade (Tab. II).

In patients in whom the desired reaction was not seen, we increased the exposure in increments of 250 msec and the power level by 250 mW, up to 2000 msec and 2000 mW. The duration and power levels were reduced in cases with an early reaction. A mean of 19 laser shots were made around the retinal tears (Tab. II). Patients were seen at 1 day, 2 weeks and 1 month, then at 3-month intervals. Redetachment after a minimum of 2 weeks of re-attachment was taken as recurrent detachment.

RESULTS

The follow-up periods varied between 3 and 15 months, averaging 7 months. Retinal attachment was achieved with one operation in 36/52 eyes (Tab. III). Adequate chorioretinal adhesion around the retinal tears was achieved in 34 patients. Additional transpupillary argon laser was applied to two patients (4%) 15 days after the first operation, because of nonappearance of adequate photocoagulation scars. In the four patients with dialysis, chorioretinal adhesion was appropriate. Detachment recurred in 16 cases after 2-9 weeks (mean 4 weeks). Explant revision and additional transscleral diopexy were needed for six (12%) and vitreoretinal surgery for ten patients with severe PVR to achieve retinal re-attachment. All the retinas were still attached six months after surgery (Tab. III). The peroperative and postoperative complications are listed in Table IV.

After scleral buckling procedures 42 patients achieved an improvement in the visual acuity, the exceptions being ten cases with advanced PVR, in whom final vision did not improve beyond light perception. Eight of these ten had an improvement in visual acuity after vitreoretinal surgery, while the remaining two stayed at the same level (Tab. V).

TABLE I - PREOPERATIVE AND POSTOPERATIVE PROLIFERATIVE VITREORETINOPATHY (PVR) GRADES ACCORDING TO THE RETINA SOCIETY CLASSIFICATION (14)

Clinical signs	PVR grade	Preoperative		Postoperative	
		no.	(%)	no.	(%)
Vitreous haze and pigment	A	9	(17.3)	7	(13.5)
Wrinkling of the inner retinal surface, rolled edge of break, vessel tortuosity	B	17	(32.7)	14	(26.9)
Full-thickness, fixed retinal folds in one quadrant	C1	12	(23.1)	11	(21.2)
Two quadrants	C2	9	(17.3)	10	(19.2)
Three quadrants	C3	5	(9.6)	7	(13.5)
Fixed retinal folds in four quadrants wide funnel	D1	-		2	(3.8)
Narrow funnel	D2	-		1	(1-9)
Closed funnel	D3	-		-	

DISCUSSION

In the 1990s the diode laser's potential for transscleral retinopexy was observed in trials by Jennings (15) (1990), Smiddy (16) (1992) and Benner et al (17) (1995). The results indicated that the diode laser passes across the conjunctiva and sclera and is absorbed by the choroid and RPE, creating a well-controlled reaction with chorioretinal adhesion. The first trial in human beings was made by Haller et al (18) in 1993, with a favorable outcome in 10 primary rhegmatogeneus retinal detachment patients. Numerous investigators then began to use transscleral diode laser retinopexy, with encouraging results (19, 20).

In our experience the dosage used in the first applications to obtain the desired effect was greater than the dosage used in subsequent applications. The least energy is needed when the aiming beam is narrowest

TABLE II - SURGICAL PROCEDURES

Procedures	no.	(%)
Subtenon anesthesia	49	94.2
General anesthesia	3	5.8
Circumferential buckling	52	I00
Circ. and local buckling	48	92.3
No. of shots (mean)	9-57 (19)	-
Intravitreal 20% SF6	30	57.7
Intravitreal air	6	11.5
Postoperative transpupillary laser	2	3.8

SF6 = sulfur hexafluoride

TABLE III - RETINAL ATTACHMENT AND RE-DETACHMENT RATES

Retinal	Scleral buckling		Explant revision		PPV		Final success	
	no.	(%)	no.	(%)	no.	(%)	no.	(%)
Attachment	36	(69.2)	6	(11.6)	10	(19.2)	52	(100)
Re-detachment	16	(30.8)	10	(19.2)	-		-	

PPV= pars plane vitrectomy

TABLE IV - PEROPERATIVE AND POSTOPERATIVE COMPLICATIONS

Complications	Peroperative		Postoperative	
	no.	(%)	no.	(%)
Corneal edema	4	(7.5%)	3	(5.5%)
Flare in AC/Vitreous	-		5	(9.5%)
Myosis	4	(7 5%)	-	
Missed tear	6	(11%)	-	
High IOP	6	(11%)	8	(15%)
Scleral burn	5	(9.5%)	-	
Iatrogenic tear	3	(5.5%)	-	
Recurrent detachment	-		16	(31%)
Explant rejection	-		2	(4%)
Insufficient retinopexy		-	2	(4%)
Increasing PVR	-		10	(19%)
Subretinal hemorrhage	3	(5.5%)	-	

AC = anterior chamber; IOP = intraocular pressure; PVR = proliferative vitreoretinopathy

TABLE V - CHANGE IN VISUAL ACUITY

	LP(+)		LP-5/200		5/200 - 20/200		>20/200	
Visual acuity	**no.**	**(%)**	**no.**	**(%)**	**no.**	**(%)**	**no.**	**(%)**
Preoperative	18	(34.6)	16	(30.8)	14	(26.9)	4	(7.7)
Postoperative	10	(19.2)	8	(15.4)	10	(19.2)	24	(46.2)

L= light perception

and most narrowly focused. As s/he gains experience, the surgeon can focus the light more easily achieving the desired effect with smaller doses. Moderate scleral burns occurred in five patients due to a high energy level. The scleral burn is like the one caused by overtreatment with diathermy for homeostasis in anterior segment surgery, where a brown pigmentation appears at the site of contact. Apart from this color change, neither necrosis nor contraction occurred. In addition three patients had temporary subretinal hemorrhage with a diameter of 1/2 the optic disc, due to high dosage at the point of retinopexy. With the increasing number of applications we learned to achieve an easier and more manipulative reaction with less energy.

Half of the patients had PVR stage C1 and above before the diode laser application. We chose these patients with PVR grades above C1 so as to reduce the need for vitreoretinal surgery, with its complications. However, we had to perform vitreoretinal surgery on ten patients. In our opinion this was because of worsening of already present PVR rather than a complication of diopexy. Postoperative conjunctival and eyelid edema, which are signs of irritation, were not noted.

Transscleral diopexy has some advantages. The red aiming beam of the diode laser makes the application area easier to be seen. We also noticed that the reaction appearing over the retina lasted throughout the rest of the operation thus helping avoid overtreatment. Diode laser can be applied in eyes with solid silicone buckling elements, over the extraocular muscles and glaucoma setons (21). In six patients, we were able to perform diopexy over silicon exoplants.

Besides its advantages, the diode laser may cause some complications. Scleral burns may occur with higher energy levels or in the presence of scleral pigmentation (20, 22-24). In order to prevent these effects, a moist application site and scleral control after each ten shots is recommended. Localized subretinal hemorrhage around the laser treatment area and breakage of the Bruch's membrane are reported as additional complications (20). There are reports stating that these complications do not cause an unfavorable outcome (18-20), as we observed in our series. Achieving the desired effect with less energy depends to some extent on the surgeon's experience.

The laser spot occurring with diopexy on a 1-mm sclera is around 0.6-0.8 mm. Scleral indentation increases the passage of laser energy (22). Other important factors in achieving an appropriate chorioretinal adhesion are the thickness of the sclera, the degree of melanin pigmentation in the retina and choroid, choroidal blood flow and the amount of subretinal fluid. Starting from low-power dosage and a short interval, both can be increased gradually until the desired adhesion appears, in cases where the physician is not sure about the tissue response. If the desired tissue response is still not achieved, first the time and then the power level may be increased as an alterantive method. Diode laser retinopexy has a power-level dependent effect. Low levels of power with long exposure create the same amount of burn as short exposure with higher power. Long exposure and low power levels can be used to create a slower, more controlled burn (16). The aim of the treatment is to achieve a slight gray-colored retinal reaction, just like with the transpupillary diode laser. When this kind of reaction appears the foot pedal must be released to terminate the photocoagulation. If the reaction appears sooner than expected, then both the exposure and the power level must be reduced to obtain a well-controlled reaction.

In conclusion, transcleral diode laser retinopexy is a safe and effective means of creating chorioretinal adhesion during retinal detachment surgery, with accurate lesion location, concurrent permanent laser marks on the retina, and easy transmission through the extraocular muscles and solid buckling elements. Minor complications were minimized as further experience was gained with the technique.

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