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Long-Term Results from an Epiretinal Prosthesis to Restore Sight to the Blind

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Purpose: Retinitis pigmentosa (RP) is a group of inherited retinal degenerations leading to blindness due to photoreceptor loss. Retinitis pigmentosa is a rare disease, affecting only approximately 100 000 people in the United States. There is no cure and no approved medical therapy to slow or reverse RP. The purpose of this clinical trial was to evaluate the safety, reliability, and benefit of the Argus II Retinal Prosthesis System (Second Sight Medical Products, Inc, Sylmar, CA) in restoring some visual function to subjects completely blind from RP. We report clinical trial results at 1 and 3 years after implantation.

Design: The study is a multicenter, single-arm, prospective clinical trial.

Participants: There were 30 subjects in 10 centers in the United States and Europe. Subjects served as their own controls, that is, implanted eye versus fellow eye, and system on versus system off (native residual vision).

Methods: The Argus II System was implanted on and in a single eye (typically the worse-seeing eye) of blind subjects. Subjects wore glasses mounted with a small camera and a video processor that converted images into stimulation patterns sent to the electrode array on the retina.

Main Outcome Measures: The primary outcome measures were safety (the number, seriousness, and relatedness of adverse events) and visual function, as measured by 3 computer-based, objective tests.

Results: A total of 29 of 30 subjects had functioning Argus II Systems implants 3 years after implantation. Eleven subjects experienced a total of 23 serious device- or surgery-related adverse events. All were treated with standard ophthalmic care. As a group, subjects performed significantly better with the system on than off on all visual function tests and functional vision assessments.

Conclusions: The 3-year results of the Argus II trial support the long-term safety profile and benefit of the Argus II System for patients blind from RP. Earlier results from this trial were used to gain approval of the Argus II by the Food and Drug Administration and a CE mark in Europe. The Argus II System is the first and only retinal implant to have both approvals. *Ophthalmology 2015;■:1–8 © 2015 by the American Academy of Ophthalmology. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).*

Supplemental material is available at www.aaojournal.org.

This study presents 3-year results from the ongoing clinical trial of the Argus II Retinal Prosthesis System (Second Sight Medical Products, Inc., Sylmar, CA). The study's purpose is to evaluate the safety and benefit of the Argus II System in providing functional vision to people blind from retinitis pigmentosa (RP).

Several different approaches to restoring sight to those blind from retinal degeneration are currently under investigation, including stem cell therapy,[1] gene therapy,[2,3] and other approaches.[4] Visual prostheses offer the possibility of restoring vision in patients who are severely blinded from RP and other retinal degenerations. Different visual prostheses have been explored, including visual cortex,[5,6] optic nerve,[7] epiretinal,[8] and subretinal[9] devices. Although many approaches show promise, to date, retinal prostheses are the only therapy to have achieved market approval in the United States and Europe. A previous report[8] presented data from this cohort when all subjects had reached 6 months of follow-up. We present complete 1-year and 3-year data from the Argus II clinical trial.

Methods

Study Design

The study is a single-arm, prospective, unmasked clinical trial. Because of the rarity of the eligible patient population, the sample size was 30 subjects, which was determined, with guidance from

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regulatory agencies, to be reasonably achievable and of sufficient power to evaluate safety and probable benefit. These 30 subjects were enrolled at 10 centers in the United States and Europe. Subjects served as their own controls (i.e., tested with the Argus II System turned on vs. using only their residual vision). The trial was and continues to be conducted in accordance with the Declaration of Helsinki and the national regulations for medical device clinical trials in the respective countries where the study is being conducted. The study has been approved by the national ministries of health in these countries and the ethics committees or institutional review boards of participating institutions. All subjects signed informed consent to participate. The clinical trial is posted on www.clinicaltrials.gov, trial registration number NCT00407602.

Inclusion and Exclusion Criteria

Subjects were eligible to enroll if they had a confirmed diagnosis of RP (United States) or outer retinal degeneration (Europe), bare or no light perception in both eyes, functional ganglion cells or optic nerve (confirmed by photoflash detection or measurable electrically evoked response), and a history of useful form vision. Age inclusion criterion was initially $\geq$50 years and was later changed to 25 years in the United States and Switzerland and 18 years in France and the United Kingdom.

Exclusion criteria included diseases or conditions that affected retinal or optic nerve function, ocular structures, or conditions that could prevent successful implantation, and any inability to tolerate the implant surgery or medical/study follow-up. Full inclusion and exclusion criteria are listed at www.clinicaltrials.gov.

Device

The Argus II System consists of an active device implanted on and in the eye and external equipment worn by the user. The implanted portion of the system includes a receiving antenna and an electronics case that are fixed outside the eye with sutures and a scleral band, and an intraocular 6 $\times$ 10 electrode array that is tacked over the macula epiretinally (i.e., on the retinal ganglion cell side) (Fig 1A). The external portion of the system includes a glasses-mounted video camera and a small video processing unit (VPU) (Fig 1B) that can be worn on a shoulder strap or belt (not shown). The camera collects visual information and sends it to the VPU, which down-samples and processes the image. Several buttons on the VPU allow user control of various image-processing algorithms, for example, enhancing contrast. Data and power are sent wirelessly from a transmitting antenna on the glasses to the internal receiving antenna. The electrodes in the array emit pulses of electricity whose amplitude corresponds to the brightness of the scene in that location. Stimulation of the remaining retinal cells induces cellular responses that travel through the proximal visual system, resulting in visual percepts that subjects learned to interpret.

Surgical Procedure

Subjects received the Argus II Retinal Prosthesis System in 1 eye, typically the worse-seeing eye. The surgical procedure is summarized as follows; a more detailed description of the procedure and medication regimen is in the online Appendix (available at www.aaojournal.org).

To implant the device, a 360-degree limbal conjunctival peritomy was performed. The rectus muscles were isolated, and the coil was inserted temporally on the globe and centered under the lateral rectus muscle. The electronics package was centered in the superotemporal quadrant. The inferior part of the scleral band was passed under the inferior and the medial rectus muscles, and the superior portion of the band under the superior rectus muscle. The implant was fixed to the eye via sutures passed through suture tabs on the implant in both temporal quadrants, and a Watzke sleeve (Labtician Ophthalmics, Inc, Oakville, Ontario, Canada) and mattress sutures or scleral tunneling were used to secure the scleral band in the nasal quadrants.

A core and peripheral vitrectomy were conducted. The array was then inserted through a temporal sclerotomy. The electrode array was placed on the retina in the macular region and then tacked using a custom retinal tack (Second Sight Medical Products, Inc, Sylmar, CA). The extraocular portion of the cable was sutured to the sclera, and all sclerotomies were closed.

An allograft (or suitable alternative in countries where allografts were not permitted) was fixed over the device to reduce the likelihood of conjunctival irritation. Finally, the Tenon's capsule and the conjunctiva were closed.

Assessment of Safety: Primary End Point

All adverse events were collected and reported as necessary to the relevant authorities and ethics committees. Adverse events were classified by relatedness (device- or surgery-related, or subject-related) and whether they met the regulatory definition of "serious" (i.e., adverse events that required medical or surgical intervention or hospitalization to prevent permanent injury). Serious adverse events (SAEs) were distinguished from those for which treatment was unnecessary or noninvasive (nonserious). Therefore, a particular type of adverse event, such as hypotony, may have been considered nonserious or serious, depending on how or whether that particular event was treated. All adverse events were subject to detailed review and adjudication by an independent medical safety monitor.

Assessment of Visual Function: Primary End Point

The primary end point for the evaluation of benefit was visual function. This was assessed with 3 computer-based, objective tests of basic visual skills developed by Second Sight with input from the low-vision research community to cover the range of low vision restored by a retinal implant.

In "Square Localization," subjects had to locate and touch a white square in random locations on a black touchscreen monitor. The response error (the distance between the subject's response and the center of the target square in centimeters) was recorded and averaged over 40 trials. The mean error with the system on and off for each subject was evaluated with a 2-tailed t test assuming unequal variances to determine whether the on and off results were significantly different.

In "Direction of Motion," a white bar moved across the same black touch screen and subjects drew the direction they perceived the bar to be moving. The response error (the difference between the subject's response angle and the target bar's angle in degrees) was recorded and averaged over 80 trials. A 2-tailed t test was performed to determine whether the mean errors with the system on and off were significantly different.

Finally, "Grating Visual Acuity" measured subjects' visual acuity on a scale of 2.9 to 1.6 logarithm of the minimum angle of resolution (logMAR) (20/15887−20/796 in Snellen notation) using black and white gratings displayed for 5 seconds. In a 4-alternative forced-choice test, subjects indicated the perceived orientation (horizontal, vertical, diagonal left/right); the program adaptively reduced or increased the spatial frequency of the gratings on the basis of the number of correct and incorrect answers. Subjects whose performance was no better than chance were scored as acuity "worse than 2.9 logMAR."

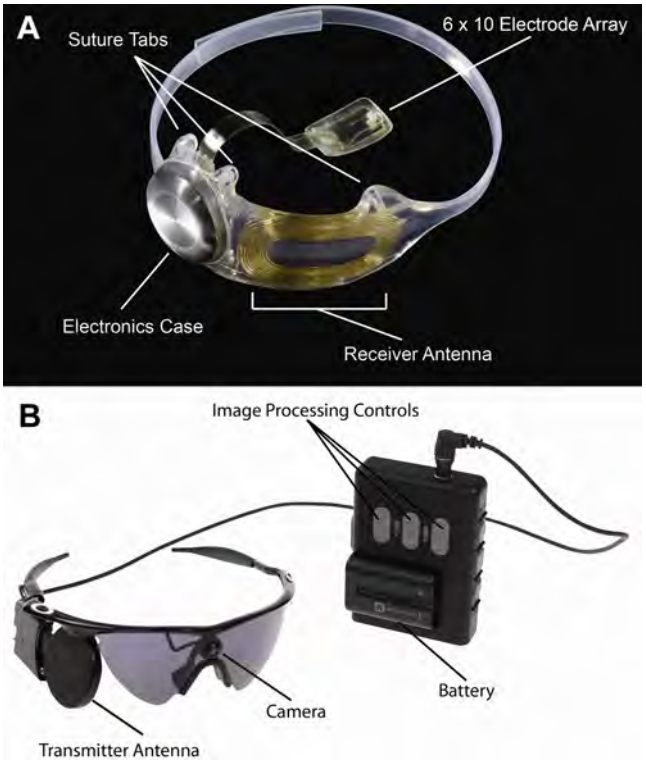

Figure 1. **A**, The implanted portions of the Argus II System (Second Sight Medical Products, Inc., Sylmar, CA). **B**, The external components of the Argus II System. Images in real time are captured by the camera mounted on the glasses. The video processing unit down-samples and processes the image, converting it to stimulation patterns. Data and power are sent via radiofrequency link from the transmitter antenna on the glasses to the receiver antenna around the eye. A removable, rechargeable battery powers the system.

Assessment of Device Reliability: Secondary End Point

Device stability and reliability were tracked by 2 measures: number of explants (surgical removal of all or a portion of the implanted device) and number of device failures (inability of the device to function).

Assessments of Orientation and Mobility, Activities of Daily Living, and Quality of Life: Secondary End Points

Assessments of performance in more real-world conditions were made with indoor orientation and mobility tasks involving finding and touching a "door" and following a white line on the floor. In the "Door Task," subjects walked across a room and tried to find and touch a simulated door (black cloth on a light wall, in 1 of 2 positions relative to the subject's starting point). In the "Line Task," subjects walked across a floor consisting of black rubber interlocking tiles. A 6-inch-wide white line painted on the tiles was configured to be straight or to have a 90° turn to the left or right. Six trials were performed with the system on and off, and successes (touching the door or ending on the line at its end point) or failures and time to completion were recorded. Detailed methods have been described.[8]

At the beginning of the study, patient-reported activities of daily living and quality of life were assessed with the VisQoL vision-related utility instrument[10] and the Mass of Activity Inventory.[11] These instruments were not fully validated in patients with RP with minimal or no sight and thus were used primarily for exploratory purposes in this study (data not shown). Patient-reported outcomes from this study will be reported in the future.

To evaluate the impact of the Argus II System on subjects' everyday lives, the Functional Low-vision Observer Rated Assessment (FLORA) was developed at the request of and with input from the US Food and Drug Administration (FDA) and introduced partway through the trial. The FLORA was performed by independent visual rehabilitation experts to subjectively assess real-world benefit of the Argus II System. Assessors first performed an extensive interview to understand a subject's self-reported experience with the Argus II System. Next, the assessors observed the subject performing visual tasks (system on and off) in and around his or her home. Tasks were chosen by the assessors from a provided list and included orientation and mobility tasks, activities of daily living, and social interactions. Finally, the assessor wrote a case study narrative to synthesize his or her judgment of the effect of the Argus II on that subject's life, taking into account both real-world use and quality of life. All narratives then were rated by a single independent rater for the effect of the system on subjects' lives: positive, mild positive (usually subjects who self-reported functional benefits that were not supported by assessors' observations), prior positive (subjects who self-reported positive effects in the past that could not be demonstrated at the time of the assessment), neutral, and negative.

Performance was assessed on all subjects at months 3 and 6, and years 1 to 3, except the FLORA, which was performed at years 1 and 3. The number of subjects assessed by each test differed slightly because of the introduction of Square Localization and Direction of Motion tests partway through the trial, as well as some missed follow-up visits. Deviations were collected and reported to relevant regulatory agencies.

Results

A total of 30 subjects received the Argus II System between June 2007 and August 2009 at 10 different centers in the United States and Europe. Twenty-nine subjects had RP (including 1 with Leber congenital amaurosis), and 1 subject had choroideremia. Twenty-nine subjects had bare light perception (i.e., the ability to detect very bright light) in both eyes, and 1 subject had no light perception (but was able to perceive light in response to transcorneal electrical stimulation). The age at time of implant ranged from 28 to 77 years (average 58 years, standard deviation 10 years). There were 9 female and 21 male subjects. Median surgery time was 4:04 hours (range, 1:53—8:32 hours).

Safety

As of 1 year after implantation, 66.7% of subjects (20/30) had experienced no device- or surgery-related SAEs. There were 18 SAEs among 10 subjects. The SAEs fell into 10 types, with hypotony, conjunctival dehiscence, conjunctival erosion, and presumed endophthalmitis (culture negative) being slightly more common than the others. There were also 2 subjects who underwent revision surgery to re-tack the array to the retina 1 week after implantation.

At 3 years after implantation, there were a total of 23 SAEs among 11 subjects, with 2 additional SAE types. One subject's device was removed at 1.2 years to treat recurrent conjunctival erosion, as reported previously.[8] Table 1 shows the total percentage

Table 1. Percent of Subjects (N = 30) Experiencing Each Serious Adverse Event Type with 95% Confidence Intervals through Year 1 and Year 3 after Implantation (Cumulative)

SAE Type	Year 1			Year 3		
	No. of Subjects with SAE	*% of Subjects with SAE*	*95% CI*	*No. of Subjects with SAE*	*% of Subjects with SAE*	*95% CI*
Conjunctival erosion	3	10.0%	2.1–26.5	4	13.3%	3.1–30.7
Hypotony	2	6.7%	0.8–22.1	4	13.3%	3.1–30.7
Conjunctival dehiscence	3	10.0%	2.1–26.5	3	10.0%	2.1–26.5
Presumed endophthalmitis	3	10.0%	2.1–26.5	3	10.0%	2.1–26.5
Re-tack	2	6.7%	0.8–22.1	2	6.7%	0.8–22.1
Corneal opacity	1	3.3%	0.1–17.2	1	3.3%	0.1–17.2
Retinal detachment—rhegmatogenous	1	3.3%	0.1–17.2	1	3.3%	0.1–17.2
Retinal detachment—tractional and serous	1	3.3%	0.1–17.2	1	3.3%	0.1–17.2
Retinal tear	1	3.3%	0.1–17.2	1	3.3%	0.1–17.2
Uveitis	1	3.3%	0.1–17.2	1	3.3%	0.1–17.2
Keratitis—infective	0	0.0%	0.0	1	3.3%	0.1–17.2
Corneal melt	0	0.0%	0.0	1	3.3%	0.1–17.2

CI = confidence interval; SAE = serious adverse event.

of subjects experiencing each SAE type with the 95% confidence intervals for data through year 1 and year 3.

Serious adverse events were clustered toward the early postoperative period: 14 of 23 SAEs (61%) occurred within the first 6 months after implantation, and only 5 SAEs (among 4 subjects) occurred after month 12. These late SAEs were 2 cases of hypotony and 1 each of keratitis—infective, corneal melt, and conjunctival erosion. This trend also held for non-SAEs; more than half (53%) of all non-SAEs occurred within the first 6 months. Events were also clustered within patients; 3 subjects (10%) accounted for more than 55% of SAEs by 3 years after implantation, and 19 subjects had experienced no SAEs by that time. Indeed, 4 of the SAEs that occurred after year 1 were part of cascades or recurrences of events in 3 subjects. Only 1 SAE after year 1, a case of hypotony, occurred in a subject who had not previously experienced any SAEs. All SAEs were treatable with standard ophthalmic approaches, and there were no lost eyes (enucleated) in the study. A full listing and percentages of non-SAEs are in the online Appendix (available at www.aaojournal.org). Of note are 7 subjects who underwent elective revision surgeries, which involved attempts to improve the position of the array.

Visual Function

At both 1 and 3 years, in the Square Localization test, a majority of subjects performed significantly better with the system on than off; in the Direction of Motion test, more than half of the subjects performed significantly better with the system on; on Grating Visual Acuity, no subjects scored on the scale with their fellow eye (system off), whereas 33% to 48% of the subjects scored 2.9 logMAR or better with the system on (year 3 and year 1, respectively) (Table 2). The mean acuity values of those who scored on the scale were 2.5 logMAR (standard deviation, 0.3 logMAR) at year 1 and 2.5 logMAR (standard deviation, 0.4 logMAR) at year 3. The best score at these 2 time points was 1.9 logMAR (20/1588). As previously reported,[8] 1 subject scored 1.8 logMAR on this test at a different time point.

Device Reliability

Twenty-nine subjects still had functioning devices 3 years after implantation. The 1 explant was due to SAE management, rather than device failure. There were no device failures through the 3-year follow-up.

Orientation and Mobility, Activities of Daily Living, and Quality of Life

On both the Door and Line tasks, subjects perform better (higher mean percent success) when using their Argus II Systems (Table 2). On the FLORA, the effect of the system was overwhelmingly rated as positive or mild positive compared with prior positive or neutral at both year 1 and year 3; there were no ratings of negative at either time point (Table 2).

Discussion

The Argus II System was extremely reliable and stable, with no device failures within 3 years after implantation (a total of 88.2 subject-years). Some of the performance measures (Square Localization, Direction of Motion, Grating Visual Acuity, and the FLORA) seem to show a smaller percentage of subjects performing better with the system on than off (Table 2). It is unclear whether this is a true performance decline, but that is a possibility. Most of these measures (except Grating Visual Acuity) were introduced partway through the clinical trial, after year 1 for approximately half the subjects. Therefore, the year 3 results include more subjects who received implants earlier in the trial; a possible explanation could be that subjects enrolled later (who received a slightly different array design) were better performers. This is supported by the results on the Find the Door and Follow the Line tasks (Table 2), which show essentially equal performance at years 1 and 3 among the same group of 28 subjects.

Visual function results indicated that 89% of subjects performed significantly better with the system on than off for Square Localization at 3 years after implantation, 56% for Direction of Motion, and 33% scored on the scale on Grating Visual Acuity with the system on (no subjects scored with the system off). Similar proportions of system

Table 2. Assessments of Benefit

A	Year 1		Year 3	
Outcome Measure	*N*	*% Significantly Better on than off*	*N*	*% Significantly Better on than off*
Square Localization	16	93.8%	28	89.3%
Direction of Motion	16	62.5%	27	55.6%
Grating Visual Acuity	29	48.2%	27	33.3%

B						
Outcome Measure	*N*	*Mean (SD) % Success on*	*Mean (SD) % Success off*	*N*	*Mean (SD) % Success on*	*Mean (SD) % Success off*
Find the Door	28	53.0% (5.5%)	30.8% (4.8%)	28	54.2% (6.2%)	19.0% (4.3%)
Follow the Line	28	72.8% (5.7%)	17.1% (4.2%)	28	67.9% (6.5%)	14.3% (3.8%)

C								
Outcome Measure	*N*	*% Positive and Mild Positive*	*% Prior Positive and Neutral*	*Negative*	*N*	*% Positive and Mild Positive*	*% Prior Positive and Neutral*	*Negative*
FLORA	15	80%	20%	0	23	65.20%	34.80%	0

Panel A shows visual function results (primary end point). Results for Square Localization and Direction of Motion indicate the percentage of subjects whose system on results were significantly different from (better than) system off. Results for Grating Visual Acuity indicate the percentage of subjects who scored between 2.9 and 1.6 logMAR with the system on. None of the subjects scored with the system off. The proportion of subjects with significantly better system on than off results was not significantly different between 1 and 3 years for any of the visual function tests ($P > 0.05$, z test). Panel B shows the mean percentage success on the Find the Door and Follow the Line orientation and mobility assessments. Panel C shows the results of the Functional Low-vision Observer Rated Assessment (FLORA) at year 1 and year 3.

on versus off performance were reported from different data sets earlier in the clinical trial[8,12,13]; these latest results indicate that visual function benefit from the Argus II System is sustained to at least 3 years after implantation. For the 33% to 48% of subjects who scored on the Grating Visual Acuity scale with their systems on, the mean visual acuity was 2.5 logMAR. Because none of these subjects had visual acuity of 2.9 logMAR or better with the system off, this result would be equivalent to an average gain of at least 4 lines on the Early Treatment Diabetic Retinopathy Study (ETDRS) chart for these patients.

Laboratory-based orientation and mobility tests (Find the Door and Follow the Line) provide additional evidence that the system provided long-term benefit; subjects were able to perform practical tasks with more success with the system on than off to 3 years after implantation. Finally, an in-depth assessment of subjects' functional vision and well-being (the FLORA), performed by independent rehabilitation specialists, found that 80% subjects received benefit from the system at 1 year after implantation, whereas none were affected negatively.

Results to date in the Argus II Retinal Prosthesis System trial have shown no adverse safety concerns in this group of 30 subjects. Most SAEs occurred within 6 months after implantation, and all were treatable with standard ophthalmic approaches. Most (4/5) late-occurring SAEs (after 1 year) were part of a cascade of events that had begun earlier, rather than newly arising events. However, any implant intended to remain in the eye for many years carries a long-term risk. Events such as conjunctival erosion, hypotony, or endophthalmitis could occur in the long term. Therefore, any patient considering such an implant should be counseled about the need for regular (at least once per year) follow-up as long as the implant remains in the eye.

Table 3. Serious Adverse Event Rates for the Argus II System (Second Sight Medical Products, Inc., Sylmar, CA) and Comparator Devices

Adverse Event	Comparator Device or Technique		
	Retinal Tack	*Glaucoma Drainage Device*	*Argus II*
Hypotony		10% (5.1–18.4)[15]	6.7% (0.8–22.1)
Conjunctival dehiscence		11% (6.0–19.1)[15]	10.0% (2.1–26.5)
Conjunctival erosion		5% (1.5–10.6)[15]; 16% (5.4–33.7)[16]	10.0% (2.1–26.5)
Presumed endophthalmitis (culture-negative)		1% (0.03–5.1)[15]; 5% (NR)[17]	10.0% (2.1–26.5)
Dislodged tack	5.3% (1.1–15.4)[18]		6.7% (0.8–22.1)

NR = not reported.
Adverse event rates at 1 year (with 95% confidence intervals in brackets) as reported for retinal tacks or glaucoma drainage devices for each of 5 serious adverse events that occurred in >1 Argus II subject. The follow-up time reported for each published reference varies but is typically a mean of ≤12 months.

There was 1 explant due to adverse events within 3 years after implantation. In this small study of 30 subjects, it is difficult to complete a robust statistical analysis of the safety results because of limited power. There are no long-term data from other retinal prostheses to place Argus II system adverse event rates in context. However, the Argus II is implanted using a series of common vitreoretinal surgical techniques (e.g., pars plana vitrectomy) and has design elements in common with other ophthalmic devices, particularly glaucoma drainage devices and metallic tacks.[14] Therefore, a comparison can be made between these devices and the Argus II regarding key adverse event rates, as shown in Table 3, although it should be noted that the comparison studies included many more subjects in their analyses.[15–18]

The comparison indicates that Argus II rates are similar to those of glaucoma drainage devices and retinal tacks in most cases. The 1 exception was endophthalmitis, which was relatively high in the Argus II cohort (10%), although each of the 3 individual events was culture-negative, managed successfully by medical (nonsurgical) means, not related to the sterility of the device, and not associated with preexisting conjunctival erosion or hypotony. Of note, 2 of the 3 endophthalmitis cases were operated on the same day at a single site. All 3 cases occurred early in the study (within 2 months after implantation for each case and within the first year of the overall study start), and no further cases of endophthalmitis were reported up to 3 years after implantation after several procedural changes aimed at reducing the risk of infection were implemented. Changes included adding a temporary cover over the array portion of the device during the attachment of the extra-ocular portion of the device on the globe, recommendations to strengthen the sterile procedures at all surgical centers, and the addition of prophylactic intravitreal antibiotics at the end of each case.

Seven subjects underwent elective revision surgeries to attempt to improve the position of the array. These were non-SAEs because they were not medically necessary; however, they were interventions intended to improve the benefit of the device for these early subjects. No further elective revision surgeries have been conducted among all new cases since the last of these in 2010.

Conclusions

It is difficult to reach definitive conclusions about safety from this small study. Retinitis pigmentosa is a rare disease, and patients with almost total loss of vision from RP are rarer still. With only 30 subjects, statistical power is low. Among those 30 subjects, however, there were no lost eyes, all events were treated with standard ophthalmological techniques, and there were no unexpected events. The risk presented by the Argus II also must be considered in the context of these patients' profound blindness and lack of other treatment options. Their vision before the Argus II was in the range of bare light perception or less in both eyes. Generally, ophthalmic adverse events may be a concern because of the possibility of further vision loss; in these patients, residual vision is negligible, thus reducing the risk posed by these adverse events.

To our knowledge, this study is the largest and longest-running clinical trial of a retinal prosthesis to date; as of September 1, 2014, the longest duration of implant was 7.2 years. The results in these 30 subjects indicate that the Argus II Retinal Prosthesis System has an acceptable risk profile and is a beneficial therapy for profoundly blind patients with RP. Earlier results from this trial were the basis of CE Mark (commercial approval) in Europe. After an FDA-convened panel of 19 experts voted unanimously that the benefits outweighed the risks of the Argus II System, the FDA approved the System for market under the Humanitarian Device Exemption in the United States.

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Abbreviations and Acronyms:

FDA = Food and Drug Administration; **FLORA** = Functional Low-vision Observer Rated Assessment; **logMAR** = logarithm of the minimum angle of resolution; **RP** = retinitis pigmentosa; **SAE** = serious adverse event; **VPU** = video processing unit.

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