

Company Overview

January 2020

Forward Looking Statements

Forward-Looking Statements

This presentation contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. All statements contained in this presentation that do not relate to matters of historical fact should be considered forward-looking statements, including, without limitation, statements regarding expectations relating to meetings with global regulatory authorities and the FDA, product pipeline, anticipated product benefits, goals and strategic priorities, product candidate development and status and expectations relating to clinical trials, growth expectations or targets and pre-clinical and clinical data expectations in respect of collaborations, as well as statements that include the words "expect," "intend," "plan," "believe," "project," "forecast," "estimate," "may," "should," "anticipate" and similar statements of a future or forward-looking nature. These forward-looking statements are based on management's current expectations. These statements are neither promises nor guarantees, but involve known and unknown risks, uncertainties and other important factors that may cause actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by the forward-looking statements, including, but not limited to, our incurrence of significant losses; any inability to achieve or maintain profitability, acquire additional capital, identify additional and develop existing product candidates, successfully execute strategic priorities, bring product candidates to market, build-out the manufacturing facility and processes, successfully enroll patients in and complete clinical trials, accurately predict growth assumptions, recognize benefits of any orphan drug designations, retain key personnel or attract qualified employees, or incur expected levels of operating expenses; failure of early data to predict eventual outcomes; failure to obtain FDA or other regulatory approval for product candidates within expected time frames or at all; the novel nature and impact of negative public opinion of gene therapy; failure to comply with ongoing regulatory obligations; contamination or shortage of raw materials; changes in healthcare laws; risks associated with our international operations; significant competition in the pharmaceutical and biotechnology industries; dependence on third parties; risks related to intellectual property; litigation risks; and the other important factors discussed under the caption "Risk Factors" in our most recent quarterly report on Form 10-Q or annual report on Form 10-K or subsequent 8-K reports, as filed with the Securities and Exchange Commission. These and other important factors could cause actual results to differ materially from those indicated by the forward-looking statements made in this presentation. Any such forward-looking statements represent management's estimates as of the date of this presentation. While we may elect to update such forward-looking statements at some point in the future, unless required by law, we disclaim any obligation to do so, even if subsequent events cause our views to change. Thus, one should not assume that our silence over time means that actual events are bearing out as expressed or implied in such forward-looking statements. These forward-looking statements should not be relied upon as representing our views as of any date subsequent to the date of this presentation. Unless otherwise stated or the context otherwise requires, the information herein is as of January 9, 2019.



A Vertically Integrated, Clinical Stage Gene Therapy Company

Developing a new pharmaceutical modality designed for the cost effective treatment of a broad range of serious disorders

Diversified Pipeline of Gene Therapy Candidates

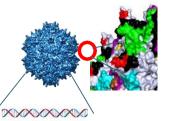
- 6 ongoing clinical programs:
- Inherited retinal diseases
- Salivary gland
- Parkinson's Disease

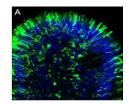




Platform of Core Viral Vector Engineering Capabilities

Viral vector design, promoters, capsid, transgene optimization, process development expertise





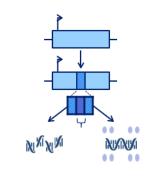
Manufacturing Capacity & Know-How

Flexible and scalable cGMP manufacturing facility with capacity for commercial supply for our programs



Next Generation Gene Therapy Riboswitch-Based Gene Regulation

Proprietary technology that may allow for innovative gene therapy treatments whose expression can be turned on and off with an easily administered small molecule



cGMP Certified Manufacturing Facility: Flexible and Scalable

Central London facility

- cGMP certified 29,000 sq. ft multi-product, multi-viral vector manufacturing facility
- Designed to meet MHRA, EMA and FDA regulatory requirements
- Single use philosophy / fully enclosed technologies
- 2 cell suites; 3 viral vector suites
- Independent air handling
- Designed for minimal downtime and maximum flexibility
- Adherent / non-adherent cell lines HEK293
- Support laboratories: Quality Control
- Adjacent MSAT (Manufacturing Science and Technology) area/pilot plant

Expanding manufacturing footprint

 Construction on 2nd cGMP viral vector manufacturing facility & cGMP plasmid production facility expected to begin in 2020





Gene Therapy Pipeline Ocular, Neurodegenerative, Salivary Gland Programs



Multiple Therapeutic Targets



Clinical Development

 Genetic Inherited Retinal Disease (IRD) franchise: XLRP, achromatopsia, RPE65-deficiency, LCA4

Research

• Wet AMD, Dry AMD

Gene Regulation

• VEGFR2 Ab – eye drops



Clinical Development

Parkinson's disease

Research

 Amyotrophic Lateral Sclerosis (ALS)

Gene Regulation

 CNS expression with BBB penetrant small molecules



Clinical Development

 Radiation-Induced Xerostomia (Grade 2/3)

Research

• Sjogren's Syndrome

Gene Regulation

 Peptide and hormone salivary gland delivery

Human proof of concept demonstrated across ocular, neurodegenerative and salivary gland pipelines

Vector development & optimization technology create opportunities to treat broader indications beyond rare, inherited genetic disorders

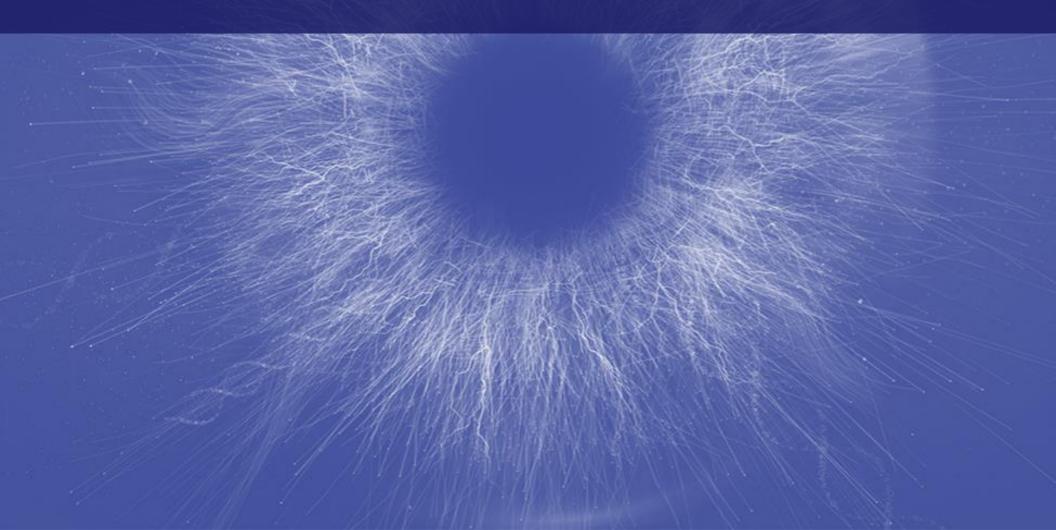
Broad Clinical Pipeline

Product	Indication	Preclinical	Phase 1/2	Details		
Ocular						
AAV-RPE65	RPE65-Deficiency	RPDD, Orphan Drug				
AAV- CNGB3*	Achromatopsia (CNGB3)	RPDD, PRIME, Fast Track, C	Orphan Drug	Janssen		
AAV- RPGR*	X-linked RP (RPGR)	Fast Track, Orphan Drug		Janssen 🕇		
AAV- CNGA3*	Achromatopsia (CNGA3)	RPDD, Orphan Drug		Janssen		
AAV-AIPL1	LCA4 (AIPL1)	Orphan U.S. & EU		EU Compassionate Use under Specials License		
A006	Wet AMD (anti- VEGFR2)					
Neu						
AAV-GAD	Parkinson's Disease (GAD)			45 patient Phase 2 trial complete		
Salivary Gland						
AAV-AQP1	Xerostomia (hAQP1)	Orphan Drug		Phase 1 study at NIH ongoing; multi-site Phase 1/2 trial ongoing		
AAV-AQP1	Sjögren's Syndrome (hAQP1)					

*Co-development program with Janssen Pharmaceuticals pursuant to a collaboration agreement.



Ocular Franchise



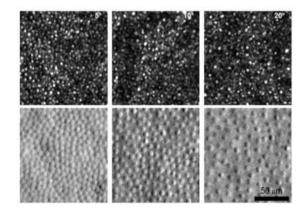
MeiraGTx Ocular Programs

	Ophthalmology Partners and Centers of Excellence					
LUCL INSTITUTE OF OPHTHALMOLOGY	 UCL Institute of Ophthalmology One of the world's leading research institutes pioneering ophthalmology gene therapy 					
Moorfields Eye Hospital NHS NHS Foundation Trust	 Moorfields Eye Hospital Provides access to the world's largest catchment of patients with inherited retinal diseases, well characterized patients, prospective Natural History studies 					
KELLOGG EYE CENTER KICHELAN MEDICINE KELLOGG EYE CENTER KELLOGG EYE CENTER	 US footprint through links with University of Michigan Kellogg Eye Center, Massachusetts Eye and Ear (MEEI), Casey Eye Institute and other leading centers 					
CASEY EYE	Partnership with Foundation Fighting Blindness (FFB)					
EFIGHTING BLINDNESS	Global expertise in imaging and validated endpoints in each of our target diseases					

90

80

Our Partners Possess World Leading Imaging, Endpoint Development and Validation



Patient Accrual Study Results: Stargardt Disease (Example) Eligible Needed

HAN JC. MEN

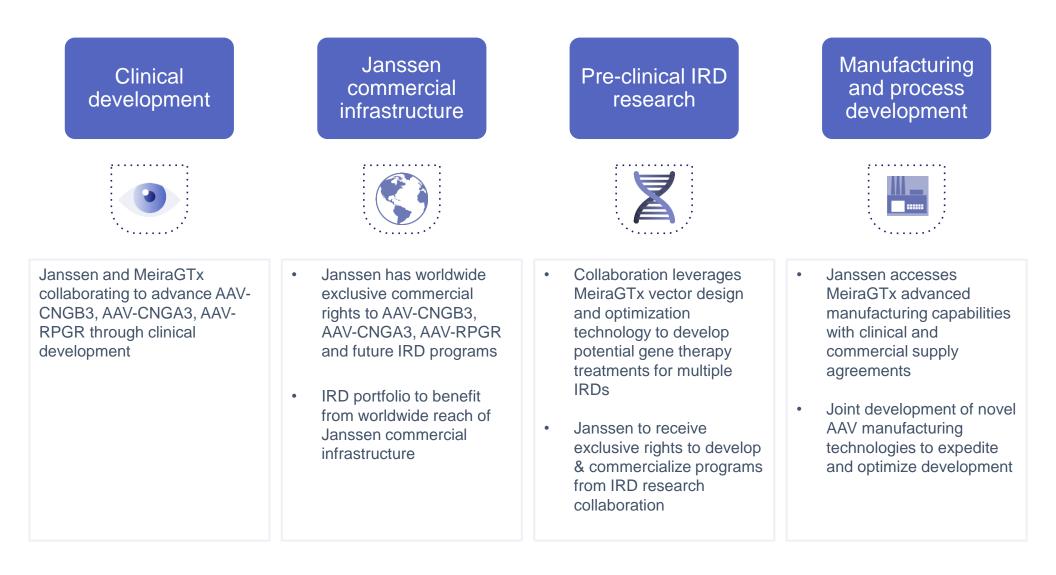
Dallas GBMC

Take Children and Children and

Patient Access

Worldwide Strategic Collaboration





AAV-RPE65 Vector Construct Optimization

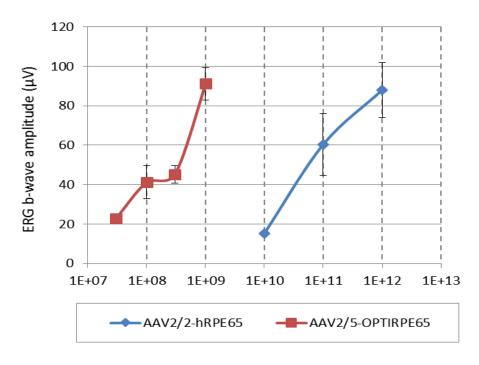
Optimization Details

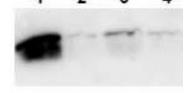
- Capsid changed from AAV2 to AAV5: 4x improvement in transfection efficiency of RPE
- **Promoter optimization:** 20x increase in protein expression
- Codon optimization: 7x increase in protein expression in human cells
- SV40 intron increases mRNA stability: 2.5x increased mRNA levels

Head-to-Head Comparison

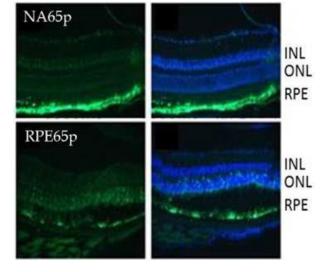
Head-to-head comparison in vivo of AAV2/5-OPTIRPE65 and AAV2/2-hRPE65, the vector used in the first UCL clinical trial

 After subretinal injection into RPE65-deficient mice, AAV2/5-OPTIRPE65 can restore retinal function at 300-1,000 fold lower doses than AAV2/2-hRPE65

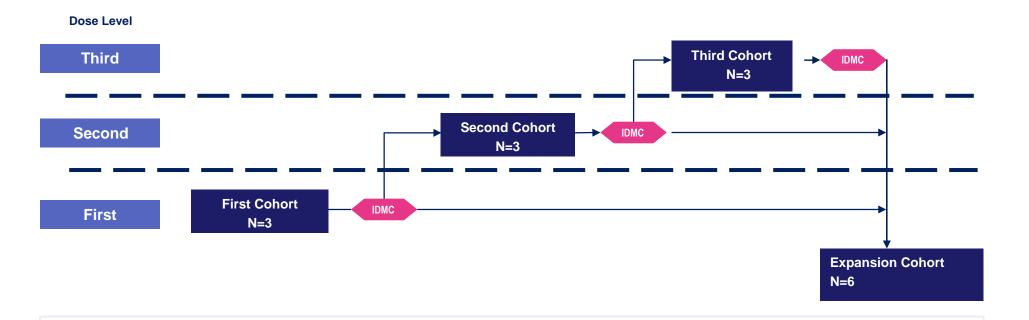




1: AAV. RPE65OPT.GFP 2: AAV. RPE65OPT.GFP (1:20 dilution) 3: AAV.BGL65p.GFP (alt promoter fragment) 4: AAV.hRPE65.GFP Subretinal injection targeting the central retina Volume of injection may be up to 1ml Multiple retinotomies permitted



Phase 1/2 Trial of AAV-RPE65



- **Dosing complete:** 15 patients treated (nine adults in three dose escalation cohorts and six pediatric patients in an expansion cohort)
- Six-month follow up data presented at AAO Retina Subspecialty Day 2019: AAV-RPE65 was generally welltolerated; statistically significant improvement across several secondary endpoints assessing clinical activity
- Long-term follow up ongoing
- Natural History study ongoing: >30 RPE65-deficiency patients well characterized

Topline Data from Phase 1/2 Trial of AAV-RPE65

AAV-RPE65 Study	 15 patients treated 9 young adults (16-24) across three dose escalation cohorts 6 children (5-12) in a pediatric expansion cohort 			
Primary Endpoint: safety	 AAV-RPE65 was generally well-tolerated after six months of follow up AAV-RPE65 safety profile consistent with other approved and investigational ocular gene therapies Subretinal injection targeting the central retina, including the fovea, was demonstrated to be well tolerated 			
Secondary Endpoints	 Mobility testing* Statistically significant improvement in the time taken to navigate a visually-guided mobility maze was demonstrated across the full spectrum of light levels tested Retinal Sensitivity** Statistically significant improvement in retinal sensitivity at six months compared to baseline (Octopus 900 full-field static perimetry) Visual Acuity** Statistically significant improvement in the ETDRS letter score from baseline to six months Contrast Sensitivity** Statistically significant improvement in contrast sensitivity from baseline to six months (Pelli-Robson assessment) 			

*Statistical significance demonstrated across entire study (cohort 1, cohort 2, cohort 3, pediatric expansion cohort)

**Statistical significance demonstrated in subset of adults and children treated at 1x10¹¹ (cohort 1, pediatric expansion cohort)

AAV-CNGB3 & AAV-CNGA3 for the Treatment of Achromatopsia

Achromatopsia (ACHM)

Retinal defect

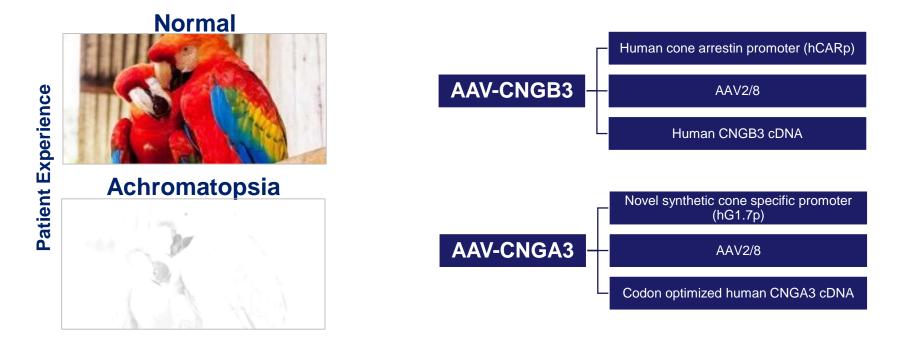
· Complete absence of cone photoreceptor function from birth

Disease characterization

- Very poor visual acuity from birth (typically 20/200)
- Photophobia (disabling aversion to light)

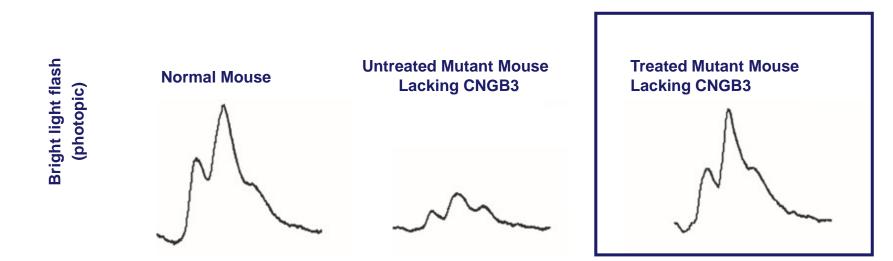
Prevalence and genes

- Overall ACHM prevalence is around 1/30,000 in US
- Total patients in US, EU5 and Japan:~24,000
- CNGB3 (~50% of cases), CNGA3 (~40% of cases)

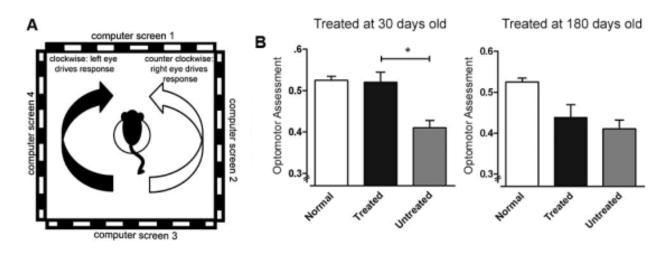


AAV-CNGB3 Restored Function in Pre-clinical Models





Restoration of visual function



Carvalho L. Long-term and age-dependent restoration of visual function in a mouse model of CNGB3-associated achromatopsia following gene therapy, Human Molecular Genetics, 2011, vol. 20.

Phase 1/2 Trials of AAV-CNGB3 and AAV-CNGA3

Achromatopsia Clinical Development Program

CNGB3 dosing complete: 23 patients treated

- 11 adults in dose escalation cohorts
- 12 children in pediatric expansion cohort)

CNGA3 clinical trial ongoing: Enrolling children aged 3-15 years old

- Dose escalation in progress
- Trial initiated Q3 2019

ACHM Natural History study ongoing

• > 90 patients well characterized

AAV-RPGR for the Treatment of X-Linked Retinitis Pigmentosa due to RPGR-Deficiency

XLRP

Retinitis Pigmentosa (RP)

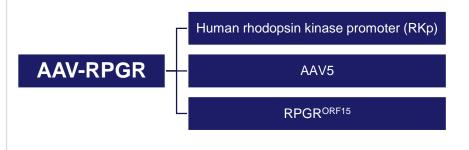
- Group of IRDs which represents the most common genetic cause of blindness
- X-linked RP is the most severe form of RP and accounts for 10-15% of RP patients

Disease progression

- · Loss of night vision
- Progressing into tunnel vision
- Blindness in 4th decade

Prevalence and genes

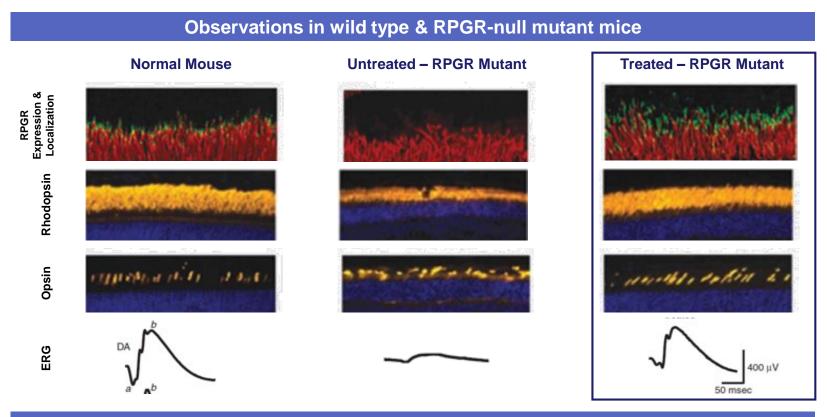
- ~1/40,000
- Total patients in US, EU5, Japan: ~20,000



Patient Experience

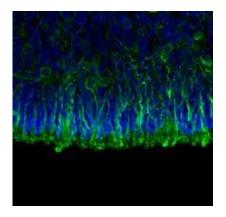


AAV-RPGR Pre-clinical Data



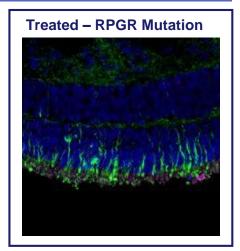
Observations in retinal organoids derived from RPGR Patients

Normal



Untreated – RPGR Mutation





Phase 1/2 Trial of AAV-RPGR

XLRP Clinical Development Program

Dose escalation complete

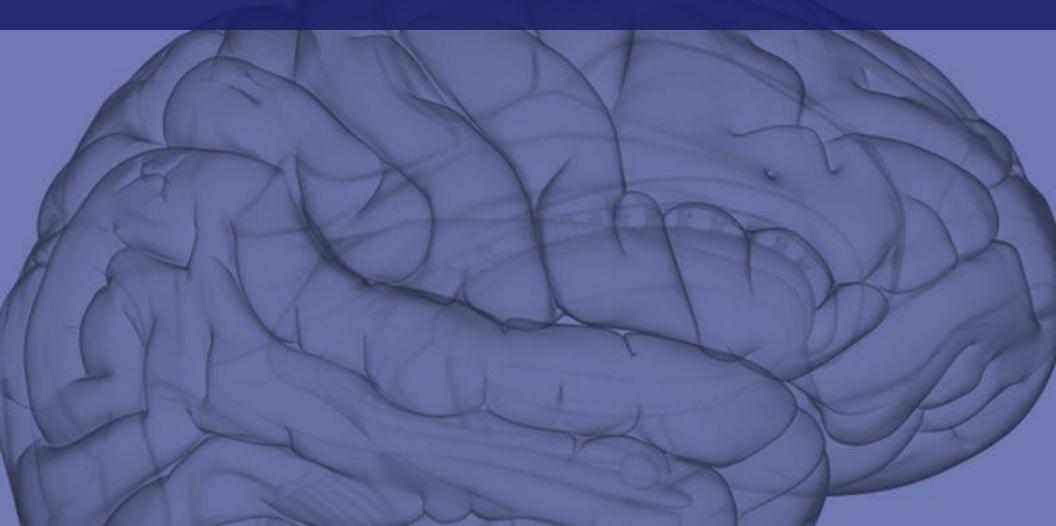
- 10 young adults (aged 18-30) treated in dose escalation
- 3 children treated in pediatric expansion cohort

Randomized, controlled extension study ongoing

- Enrolling patients in the UK and U.S.
- Natural History study ongoing
 - > 100 XLRP patients well characterized



AAV-GAD for Parkinson's Disease



Medical Needs of Parkinson's Disease Patients Today



Progressive neurodegenerative disease characterized by degeneration of dopaminergic neurons involved in motor control

- ~1M U.S. patients
- >6M patients globally
- Disease progression and motor symptoms associated with major increase in costs and decline in QoL



Large number of patients have symptoms refractory to medication adjustments

- Wearing off 40-60% by 6 years after therapy initiation
- Levodopa-induced dyskinesia (LID) 40% by 6 years after therapy initiation
- Motor fluctuations 40% by 6 years of treatment



Large unmet medical need exists to better manage motor symptoms as PD progresses

- DBS is effective, but still limited in penetration after 20 years
- High rates of non-adherence to high dose anti-Parkinsonian medications and high rates of DBS follow-up procedures and complications

Dorsey ER. Global, regional, and national burden of Parkinson's disease, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2018;17(11):939–953.

Marras C. Prevalence of Parkinson's disease across North America. npj Parkinson's Disease. 2018; 4:21

Lewin Group Report on "Economic Burden and Future Impact of Parkinson's Disease" 2019.

Kaltenboeck A. Direct costs and survival of Medicare beneficiaries with early and advanced Parkinson's disease. Parkinsonism and Related Disorders. 2012; 18(4):321-6.

Dodel RC. Health-related quality of life and healthcare utilisation in patients with Parkinson's disease: impact of motor fluctuations and dyskinesias. Pharmacoeconomics. 2001;19(10):1013-38

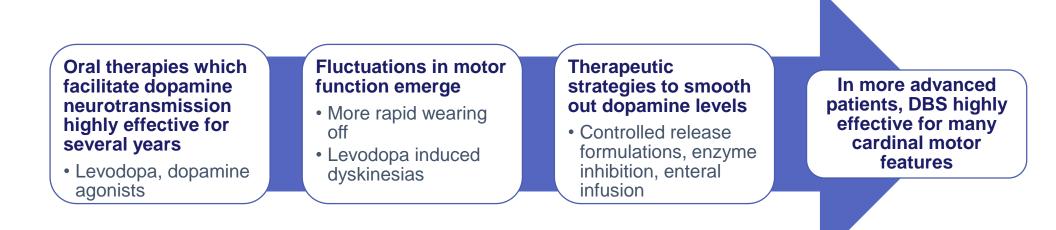
Ouma S. The Risk Factors for the Wearing-off Phenomenon in Parkinson's Disease in Japan: A Cross-sectional, Multicenter Study. Int Med. 2017; 56. 1961-1966.

Ahlskog JE. Frequency of levodopa-related dyskinesias and motor fluctuations as estimated from the cumulative literature. Mov. Disord. 2001; 16: 448-458.

Fleisher JE. Medication nonadherence in Parkinson's disease. Curr Neurol Neurosci Rep. 2013; 13(10):382.

Dahodwala. Medication adherence and discontinuation in a national cohort of Medicare beneficiaries with Advanced Parkinson's Disease. Neurology. 2019; 92 (15 Supplement)

Rationale to Go Beyond a Dopamine Strategy When Levodopa and Equivalents Fail



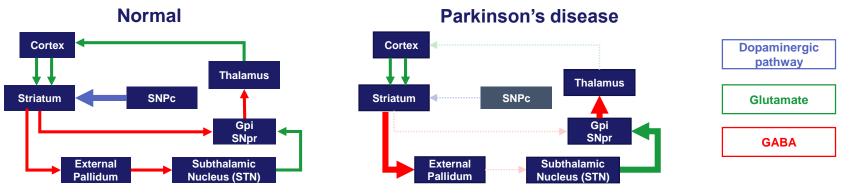
Physiological dopamine release in the putamen is synaptic and regulated

- Dopamine neurons show tonic and burst firing
- Dopamine from cell transplants or dopamine synthetic enzyme gene transfer leads to nonphysiological release
- Biological strategies to directly deliver dopamine into the putamen/caudate have been
 unsuccessful in past blinded controlled studies
 - Severe, disabling and difficult to treat dyskinesias have resulted from such approaches
- Pharmacological treatment with levodopa and DA agonists leads to changes in receptor function which make a dopamine strategy as the disease advances challenging

AAV-GAD for Parkinson's Disease

Persistent activation of STN in Parkinson's disease

- Dysregulation of basal ganglia signaling in PD with substantia nigra pars compacta (SNPc) degeneration
- Reduced GABA inhibitory input results in persistent activation of the STN
- The STN acts through the major basal ganglia output nuclei to put a brake on the thalamus
- AAV-GAD to the STN relieves this brake, enabling restoration of thalamic and cortical activity to improve motor function



AAV-GAD gene therapy to rebalance excitation and inhibition in key nuclei

<u>G</u>lutamic <u>Acid</u> <u>D</u>ecarboxylase converts glutamate (excitatory neurotransmitter) into GABA (inhibitory neurotransmitter)

- Delivered directly into the STN, bypassing circuitry disrupted by dopamine loss
- AAV-GAD converts some STN neurons to inhibitory phenotype
 - Reduce STN activity
 - Normalize neuronal firing
 - Normalize basal ganglia outflow to the motor cortex



Phase 1 Study of AAV-GAD STN Gene Therapy

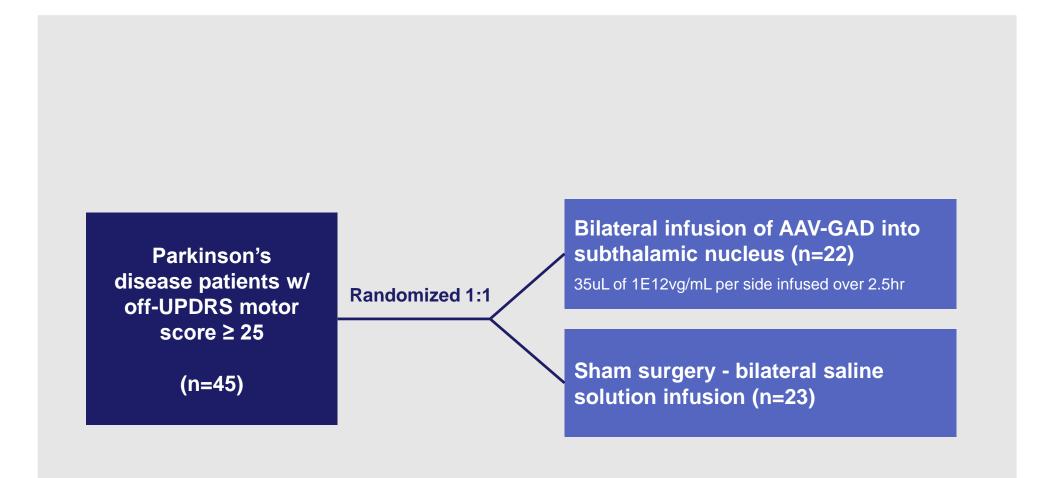
- ✓ Unilateral STN AAV-GAD was safe and well tolerated
- No evidence of induction immune response or effect on outcome of pre-immunity in two patients
- ✓ Significant improvement in both "off" and "on" UPDRS largely limited to hemibody opposite treated hemisphere
- ✓ Effects seen starting at 3 months (trend at 1 month) and stable to one year
- ✓ No decline in neuropsych scores or other non-motor parameters



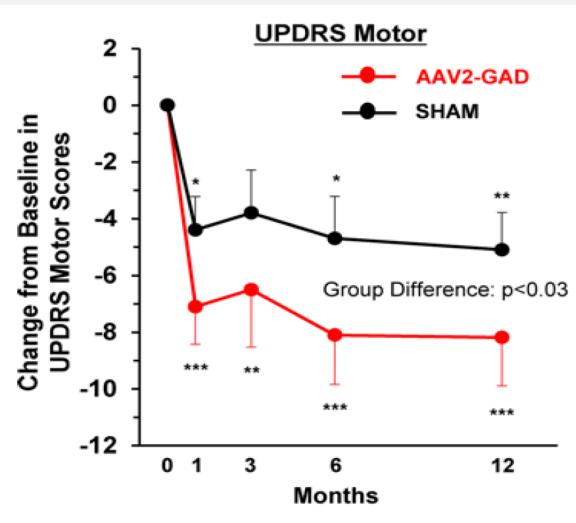


Kaplitt MG. Safety and tolerability of gene therapy with an adeno-associated virus (AAV) borne GAD gene for Parkinson's disease: an open label, phase I trial. Lancet. 2007;369:2097-2105

Randomized, Double-Blind, Sham-Surgery Controlled Phase 2 Trial of AAV-GAD



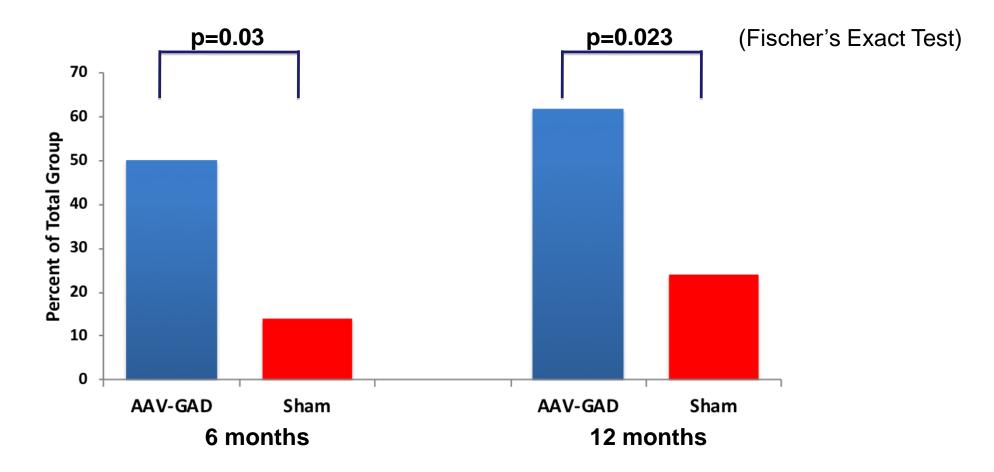
Primary Outcome Measure: Change in UPDRS Part 3 (Motor Score)



Greater improvements observed in the AAV-GAD treatment group over all follow-up time points

Group effect: p < 0.03; 2 × 5 RMANOVA; *p < 0.05, **P < 0.01, ***p < 0.001, post-hoc Bonferroni tests relative to baseline

UPDRS Part 3 Clinically Meaningful Responder Rate

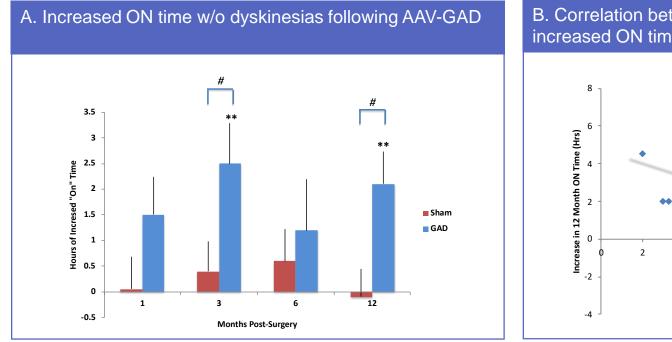


Clinically meaningful response¹

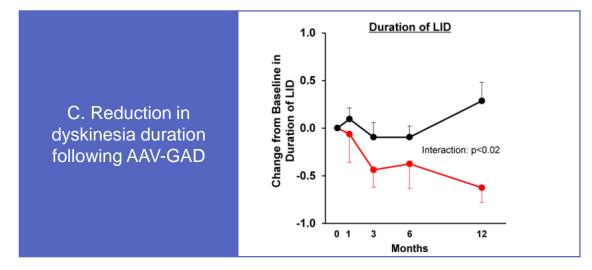
- <u>></u>9 point reduction in UPDRS Part 3 "off" scores
- Approximately 25% improvement in UPDRS Part 3 "off" scores
- Well above moderate clinically important difference (4.5-6.7 points) and close to large clinically important difference (10.7-10.8 points)²

1. Niethammer M. Long-term follow-up of a randomized AAV2-GAD gene therapy trial for Parkinson's disease. JCI Insight. 2017; 2(7):e90133 2. Shulman LM. The clinically important difference on the unified Parkinson's disease rating scale. Arch Neurol. 2010; 67(1):64-70

Increased ON Time Without Dyskinesia



Overall change in ON time GAD vs. sham p=0.044 (ANOVA)



Niethammer M. Long-term follow-up of a randomized AAV2-GAD gene therapy trial for Parkinson's disease. JCI Insight. 2017; 2(7):e90133

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Baseline ON Time (Hrs)

6

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10

12

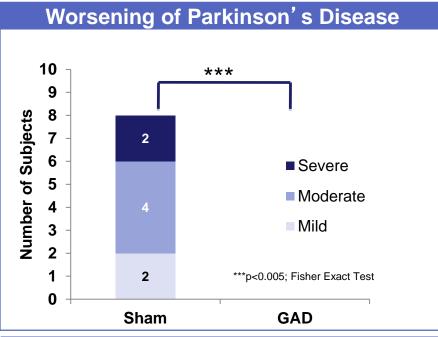
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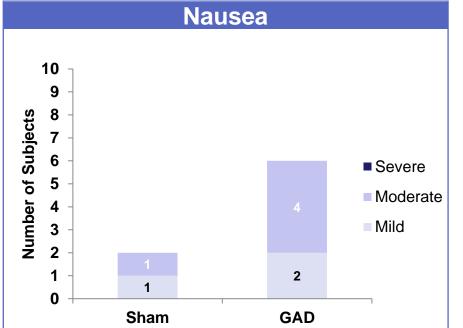
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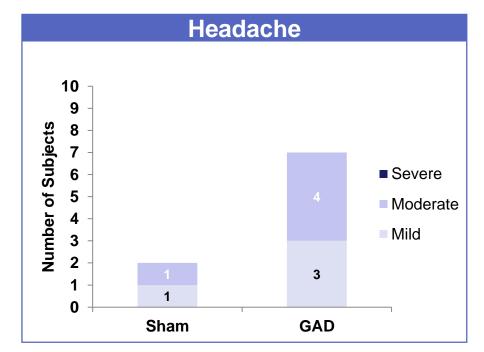
18

r= -0.59

Adverse Events Over 12 Months (20% or Greater Frequency)







Serious Adverse Events* (Number of Subjects)					
	Sham	GAD			
Intestinal obstruction		1			
Accidental drug overdose		1			
Prostatitis		1			
Delusion, Hallucination Parkinson's Disease worse	1				

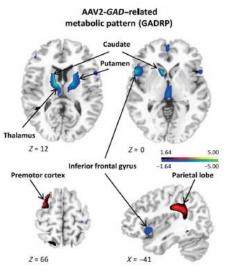
*All SAEs occurred 4-12 months post-surgery and all resolved

Metabolic Imaging Identified Biomarker of Activity

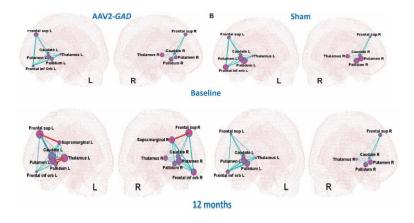
AAV-GAD reduces PD symptoms by reorganizing brain connectivity

- Metabolic imaging at baseline, 6 and 12 months
- AAV-GAD recipients developed unique treatmentdependent polysynaptic brain circuit (GAD related pattern, GADRP)
- GADRP reflects formation of new polysynaptic functional pathways linking the STN to motor cortical regions
- Statistically significant correlation between improvement in UPDRS motor ratings and GADRP expression (p< 0.009)

This treatment-induced brain circuit is a novel endpoint to isolate true treatment-driven responses from placebo responses



Decreased metabolic activity in striatum and thalamus Increased metabolic activity in premotor cortex



New polysynaptic pathways connecting STN to motor cortex

Niethammer M. Gene therapy reduces Parkinson's disease symptoms by reorganizing functional brain connectivity. Science Translational Medicine, 2018.

Summary of Key AAV-GAD Features

✓ AAV-GAD is the only gene or cell therapy:

- To meet primary clinical efficacy endpoint in a randomized, blinded multi-center PD trial
- With an imaging biomarker supporting efficacy which correlates with clinical outcome
- With a routine and brief surgical procedure that requires minimal OR time, virtually no special training, no general anesthesia
- Improvement in off-medication clinical ratings, ON time without dyskinesia and complications of medical therapy without declines in neuropsychological function or speech
- Consistency in clinical outcomes and imaging from phase 1 to phase 2
- AAV-GAD could be accessible to more patients than current standard of care
 - Absence of retained hardware
 - No need for specialized post-op care
- Non-dopaminergic strategy
 - AAV-GAD potentially applicable to large patient population not adequately treated with currently available therapies





Salivary Gland



AAV-AQP1 for Radiation-Induced Xerostomia (RIX)

Significant unmet medical need: xerostomia persisting >2 years after radiation therapy for oral cancer

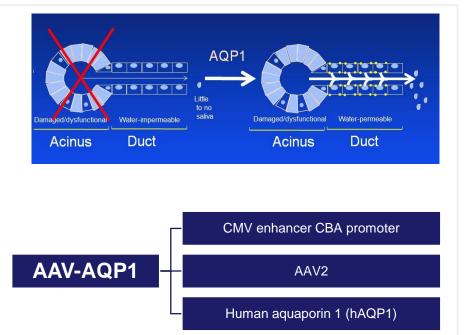
- 170,000 existing patients in the U.S.
- 50,000 new cases of head and neck cancer/yr treated in US
- 85% of radiation-treated patients experience reduced saliva production, of whom 40% have persistent Grade 2/3 RIX
- Serious, debilitating complications: dental caries, enamel erosion, oral infections, sleep disturbances, difficulty talking, chewing, swallowing, weight loss and malnutrition

Strategy for the repair

- Water-impermeable duct cells generate an osmotic gradient (lumen > interstitium)
- Introduction of human aquaporin 1 gene (hAQP1) into duct cells via viral vector, making duct cells permeable to water
- Allows water to flow into the salivary duct and out to moisten the mouth

Salivary gland as target for gene therapy

- Non-invasive: allows local administration and avoids systemic exposure
- Isolated and encapsulated
- Small volume of vector



Human Proof-of-Concept Established: Phase 1 trial of AdhAQP1

Adenoviral-mediated aquaporin-1 cDNA transfer for radiation-induced salivary hypofunction

- AdhAQP1 treatment was well tolerated: no SAEs .
- Responses seen in 2 of 3 patients in each of the first 3 cohorts .
- 60% to 540% increase in parotid flow in responding patients .
- 5 of 6 patients also reported subjective improvement in symptoms •



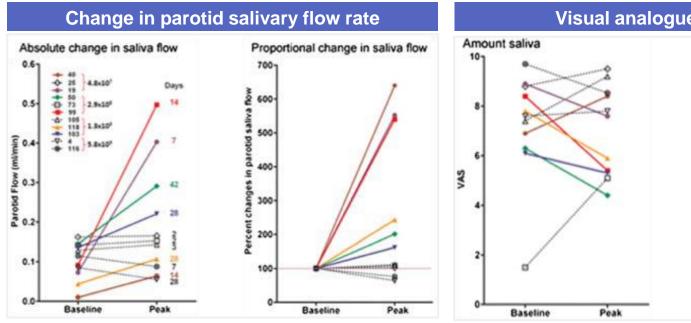
National Institute of Dental and Craniofacial Research

Dry mouth

SAV e

2

Baseline



Visual analogue scale (VAS)

Baum BJ et al. PNAS, 2012.

Peak

AAV-AQP1 Clinical Trials Ongoing

AAV-AQP1 in patients with grade 2/3 xerostomia following IR for oral cancer To determine Vector Dose Dose AAV2hAQP1 eligibility (Viral Particles per Gland) Group *0 3 X 10⁹ National Institutes 1 1 X 10¹⁰ of Health 2 3 X 10¹⁰ 3 1 X 10¹¹ 4 3 X 1011 123 1428 56 90 150*360 F/U 1-4 Study Day 5 6 X 1011 Pre 2 Pre 1 <14d <3m

• **Primary endpoint:** safety

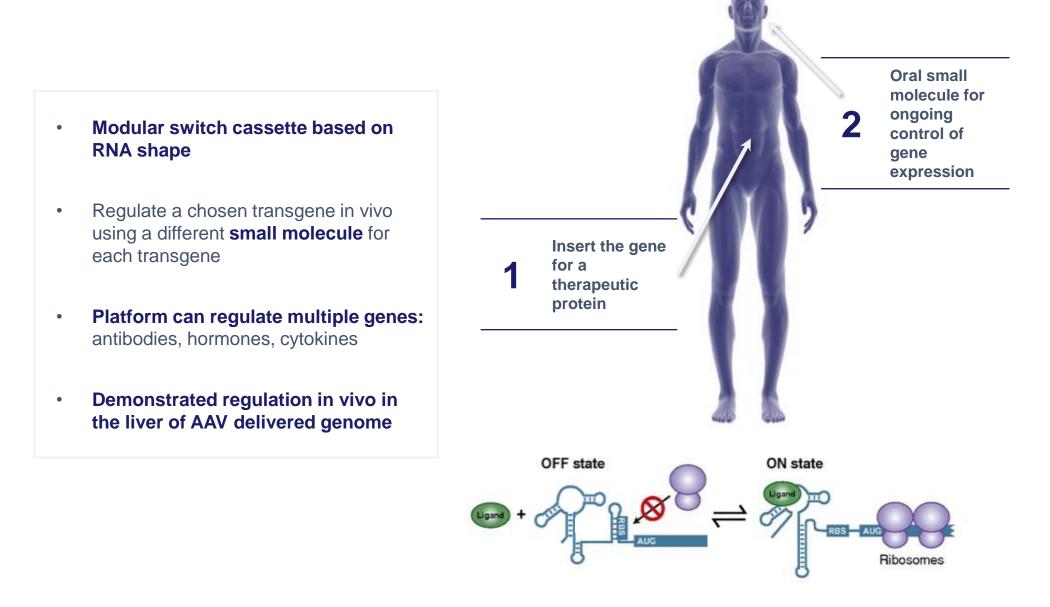
- Secondary endpoint: parotid gland salivary output
- Dose escalation ongoing
 - Single-site Phase 1 trial at NIH
 - Multi-site Phase 1/2 trial initiated Q3 2019



Gene Regulation

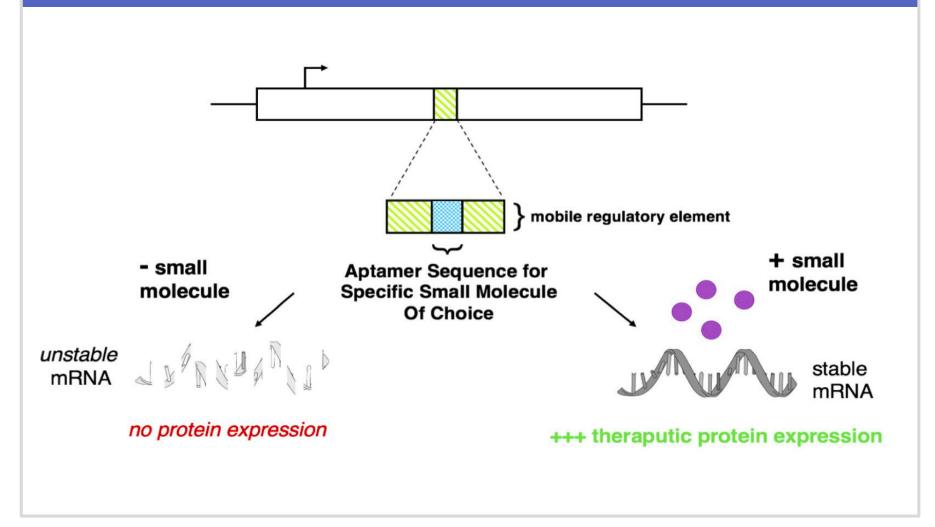


Next Generation Gene Therapy: Gene Regulation Platform



Regulation of Transgenes using Proprietary Riboswitch Technology

Regulation driven by specific small molecule / RNA binding driving functional changes in RNA configuration, splicing and translation



Regulation of Transgene Expression

