BIOGRAPHICAL SKETCH

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NAME	POSITION TITLE
Oro, Anthony Eugene	Professor
eRA COMMONS USER NAME (credential, e.g., agency login) oro.anthony	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Stanford University, Stanford, CA	BS	1985	Biochem, Molecular Bio
University of California, San Diego, La Jolla, CA	PhD	1991	Molecular Genetics
University of California, San Diego, La Jolla, CA	MD	1993	Medicine

A. Personal Statement

As a practicing Dermatologist, I have focused for the last 18 years on determinants of epithelial development, morphogenesis, and tumorigenesis using the skin as a model system. I have studied early embryonic development in Drosophila, focusing on the function of orphan nuclear receptors in pattern formation. As a post doc and now PI, I have studied the role of the hedgehog signaling pathway in skin and hair stem cell biology, hair stem cell regulation and patterning, and epithelial-mesenchymal regulation. Moreover, our work shed insights into both human cancer and regenerative medicine, two areas my lab actively investigates. I helped to establish the mechanistic link between the hedgehog pathway and basal cell carcinoma (1997), and establish one of the first human models of skin cancer by using overexpressing hedgehog pathway members in regenerating human epidermis (1997). Using these models we have investigated the basic signaling mechanisms controlling the pathway including the identification of atypical Protein Kinase C as a regulator of GLI activity, and the development of an inhibitor that specifically blocks its activity, PSI, to be used for Smo-inhibitor resistant tumors. We have also begun to use induced pleuripotent cell (iPS) technology to make patient-specific iPS cells and make genetically corrected skin epithelial sheets for patients. To improve the technology, we are investigating the determinants of stratified epithelial commitment and expansion.

B. Positions and Honors

Positions

1998-2006 Assistant Professor, Department of Dermatology, Stanford University, Stanford, CA
2006- Associate member, Stanford Comprehensive Cancer Center
2006- Associate Professor, Department of Dermatology, Stanford University, Stanford, CA
2008- Associate member, Stanford Institute Stem Cell Biology and Regenerative Medicine
2011- Professor, Department of Dermatology, Stanford University, Stanford, CA

Honors:

1981 Academic scholarship, Stanford University
1985 Honors research degree, Stanford University
1985 Fox Award, Stanford University
1987 A. Baird Hastings Honor Society, University of San Diego
1988 Howard Hughes Medical Institute, Graduate Student Award
1996 Thomas Fitzpatrick Research Award, KAO Corporation
1999 Frederick E. Terman Research Award
1999 Charles E. Culpepper Medical Scholar
2006 Nature Publishing Prize, SID Meeting
2008- Stanford Stem Cell Regulatory Board
2010 Permanent Member, ACTS study section
2012 M.H. Samitz Lectureship University of Pennsylvania

2013 Co-chair Epithelial Differentiation Gordon Conference
2014 Marion B. Sulzberger Memorial Award and Lectureship

15 US Patents Issued 1996-2014

C. Peer-reviewed Publications (out of 55 total)

Fifteen peer-reviewed research papers relevant to this application:

1. **Oro, A.E.,** McKeown, M., and Evans, R.M. (1990). Relationship between the product of the Drosophila ultraspiracle locus and the vertebrate retinoic acid responsive transcription factor, the Retinoid X receptor. ***Nature,*** 347: 298-301. PMID 2169594, PMC Journal - In Process.
2. **Oro, A.E.,** Higgins, K.M., Hu, Z., Bonifas, J.M., Epstein, E.H., and Scott, M.P. (1997). Basal Cell Carcinomas in Mice Overexpressing Sonic Hedgehog. ***Science,*** 276: 817-21. PMID 9115210, PMC Journal - In Process.
3. Fan, H., **Oro, A.E.,** Scott, M.P., and Khavari, P.A. (1997). Induction of basal cell carcinoma features in transgenic human skin expressing Sonic Hedgehog. ***Nature Med.,*** 3: 788-92. PMID 9212109, PMC Journal - In Process.
4. Callahan, C.A., Ofstad, T., Horng, L., Wang, J.K., Zhen, H.H., Coulombe, P.A., and **Oro, A.E.** (2004). MIM/BEG4, a Sonic hedgehog-responsive gene that potentiates Gli-dependent transcription. ***Genes Dev.,*** 18(22): 2724-9. PMCID: PMC528890.
5. Sarin, K.Y., Cheung, P., Gilison, D., Lee, E., Tennen, R.I., Wang, E., Artandi, M.K., **Oro, A.E.,** Artandi, S.E. (2005). Conditional telomerase induction causes proliferation of hair follicle stem cells. ***Nature,*** 436(7053): 1048-52. PMCID: PMC1361120.
6. Huntzicker, E.G., Estay, I., Zhen, H., Lokteva, L.A., Jackson, P. K., **Oro, A.E.** (2006). Dual degradation signals control Gli stability and tumor formation. ***Genes Dev.,*** 20: 276-81. PMCID: PMC1361699.
7. Bershteyn, M., Atwood, S.X., Woo, W-M., Li, M., **Oro, A.E.** (2010). MIM and cortactin antagonism regulates ciliogenesis and Hedgehog signaling. ***Dev. Cell.,*** 19(2):270-283. PMCID: PMC3108505.
8. Gomez-Ospina, N., Chang, A.L., Qu, K., **Oro, A.E.** (2012). Translocation affecting sonic hedgehog genes in basal-cell carcinoma. ***N Engl J Med.,*** 366(23):2233-4. PMCID: PMC3839666.
9. Sekulic, A., Migden, M.R., **Oro, A.E.,** Dirix, L., Lewis, K.D., Hainsworth, J.D., Solomon, J.A., Yoo, S., Arron, S.T., Friedlander, P.A., Marmur, E., Rudin, C.M., Chang, A.L., Low, J.A., Mackey, H.M., Yauch, R.L., Graham, R.A., Reddy, J.C., Hauschild, A. (2012). Efficacy and safety of vismodegib in advanced basal-cell carcinoma. ***N Engl J Med.,*** 366(23):2171-9. PMID: 22670903, PMC Journal - In Process.
10. Woo, W-M., Zhen, H.H., **Oro, A.E.** (2012). Shh maintains dermal papilla identity and hair morphogenesis via a Noggin-Shh regulatory loop. ***Genes Dev.,*** 26(11):1235-46. PMCID: PMC3371411.
11. Atwood, S.X., Tang, J., Chang, A., Li, M., and **Oro, A.E.** (2013). Gli activation by aPKC regulates BCC growth ***Nature,*** 494:484-8. PMCID: PMC3761364.
12. Yucel, G., Altindag, B., Gomez-ospina, N., Rana, A., Panagiotakos, G., Lara, M.F., Dolmetsch, R. and **Oro, A.E.** (2013). State-dependent signaling by Cav1.2 regulates hair follicle stem cell function. ***Genes Dev.,*** 27: 1217-22. PMCID: PMC3690395.
13. Melo, S., Lisowski, L., Bashkirova, E., Zhen H., Chu K., Keene, D., Marinkovich, P., Kay, M., **Oro, A.E.** (2014). Somatic scarless correction of junctional epidermolysis bullosa by a highly recombinogenic AAV virus. ***Mol Therapy,*** 22:725-33. PMCID: PMC3982486.
14. Tang, Y., Schubert, S., Bandopadhaay, P., Bergthold, G., Nguyen, B., Masoud, S., Vue, N., Balansay B., Yu, F., Oh, S., Chen, S., Ponnuswami, A., Monje-Diesseroth, M., Atwood, S.X., Whitson R.J., Lee, A., Tang, J.Y., Qi, J., Beroukhim, R., Wechsler-Reya, R., **Oro, A.E**., Bradner, J.E., and Cho, Y.J. (2014). Epigenetic Regulation of Hedgehog Pathway transcriptional output by BRD4. ***Nature Med****., in press*
15. Sebastiano, V., Zhen, H.H., Derafshi, B.H., Bashkirova, L., Melo, S., Wang, P., Leung, T., Siprashvili, Z., Tichy, A., Li, J., Ameen, M., Hawkins, J., Lee, S., Li, L., Bauer, G., Lisowski, L., Kay, M., Kim, S.K., Lane, A.T., Wernig, M. and **Oro, A.E.** (2014). Corrected Induced Pleuripotent Stem Cell Based Therapy for the Treatment of Recessive Dystrophic Epidermolysis Bullosa. *Under review at Science Translational Medicine*

Five peer-reviewed "review articles" relevant to this grant application:

1. **Oro, A.E.** and Scott, M.P. (1998). Splitting Hairs: Dissecting Roles of Signaling Systems in Epidermal Development. ***Cell,*** 95: 575-578. PMID: 9845357, PMC Journal - In Process.

2. **Oro, A.E.** (2007). The Primary cilia, a 'Rab-id' transit system for hedgehog signaling. ***Curr Opin Cell Biol.,*** 19: 691-6. PMCID: PMC3761365.
3. Woo, W-M., **Oro, A.E.** (2011). SnapShot: hair follicle stem cells. ***Cell***, Jul 22;146(2):334-334.e2. PMCID: PMC4006068.
4. Atwood, S.X., Chang, A.L.S., and **Oro, A.E.** (2012). Hedgehog pathway inhibition and the race against tumor evolution***. J Cell Biol***., 199:193-7. PMCID: PMC3471227.
5. Atwood, SX and **Oro, AE** (2014) "Atypical" Regulation of Hedgehog-dependent cancers *Cancer Cell* 25:133-4

D. Research Support

On Going Support

R01 AR46786 (Anthony E. Oro, PI) 4/17/2000 – 3/31/17
NIH
Stromal Regulation of Basal Cell Carcinoma Formation
The major goal of this project is to understand the molecular basis of epithelial regulation of Shh signaling and tumor resistance. We have used genomics and bioinformatics approaches to examine how tumors evolve.

R01 AR054780 (Anthony E. Oro, PI) 9/1/07-8/31/18
NIH
Regulating Gli Function in Hair Follicle Progenitors
The major goal of this project is to understand the regulation of hair follicle epithelial stem cell signaling by the Gli transcription factor.

California Institute for Regenerative Medicine (Anthony E. Oro, Co-PI) 05/1/10-1/31/15
iPS cell Based Therapy for Dystrophic EB
The major goal of this project is to develop a detailed understanding and protocol to produce patient-specific epithelial sheets carrying genetically-corrected keratinocytes from induced pleuripotent cells. This grant seeks to demonstrate the efficacy of reprogramming vectors and to develop the clinical protocols. There is no scientific or budgetary overlap with the present proposal.

V Foundation Grant (Oro PI) 10/01/12-10/01/15
Novel Therapies for Hedgehog-Dependent Cancers
Completion of this project will provide greater insight into the mechanism of tumor evolution and knowledge about the efficacy of promising new therapies for human cancer.

R01 AR052785-6 (Anthony E. Oro, PI) 07/01/2005-06/30/19
NIH
MIM Function in Epithelial Neoplasia
The major goal of this project is to understand how the BAR domain-containing MIM protein functions in controlling primary cilium formation, epithelial morphogenesis and cellular invasion using Drosophila and mouse genetics.