

6 Literatur

- Akerstrom, B., Brodin, T., Reis, K. und Bjorck L.** (1985). Protein G: A powerful tool for binding and detection of monoclonal and polyclonal antibodies. *J Immunol* 135, 2589-2592.
- Alcedo, J. und Noll, M.** (1997). Hedgehog and its patched-smoothed receptor complex: a novel signalling mechanism at the cell surface. *Biol Chem* 378, 583-590.
- Altschul, S. F., Gish, W., Miller, W., Myers, E. W. und Lipman, D. J.** (1990). Basic local alignment search tool. *J Mol Biol* 215, 403-410.
- Amizuka, N., Karaplis, A. C., Henderson, J. E., Warshawsky, H., Lipman, M. L., Matsuki, Y., Ejiri, S., Tanaka, M., Izumi, N., Ozawa, H. und Goltzman, D.** (1996). Haploinsufficiency of parathyroid hormone-related peptide (PTHrP) results in abnormal postnatal bone development. *Dev Biol* 175, 166-176.
- Andersson, H. C.** (2002). Disorders of post-squalene cholesterol biosynthesis leading to human dysmorphogenesis. *Cell Mol Biol (Noisy-le-grand)* 48, 173-177.
- Ausubel, F. M., Brent, R., Kingston, R. E., Moore, D. D., Seidman, J. G., Smith, J. A. und Struhl, K.** (1987-1999). *Current protocols in molecular biology* (New York, Green and Wiley-Interscience).
- Balemans, W. und Van Hul, W.** (2002). Extracellular regulation of BMP signaling in vertebrates: a cocktail of modulators. *Dev Biol* 250, 231-250.
- Becker, S., Wang, Z. J., Massey, H., Arauz, A., Labosky, P., Hammerschmidt, M., St-Jacques, B., Bumcrot, D., McMahon, A. und Grabel, L.** (1997). A role for Indian hedgehog in extraembryonic endoderm differentiation in F9 cells and the early mouse embryo. *Dev Biol* 187, 298-310.
- Bell, E. J. und Brickell, P. M.** (1997). Replication-competent retroviral vectors for expressing genes in avian cells in vitro and in vivo. *Mol Biotechnol* 7, 289-298.
- Bitgood, M. J. und McMahon, A. P.** (1995). Hedgehog and Bmp genes are coexpressed at many diverse sites of cell-cell interaction in the mouse embryo. *Dev Biol* 172, 126-138.
- Bitgood, M. J., Shen, L. und McMahon, A. P.** (1996). Sertoli cell signaling by Desert hedgehog regulates the male germline. *Curr Biol* 6, 298-304.

- Bjorck, L. und Kronvall, G.** (1984). Purification and some properties of streptococcal protein G, a novel IgG-binding reagent. *J Immunol* 133, 969-974.
- Briscoe, J., Chen, Y., Jessell, T. M. und Struhl, G.** (2001). A hedgehog-insensitive form of patched provides evidence for direct long-range morphogen activity of sonic hedgehog in the neural tube. *Mol Cell* 7, 1279-1291.
- Bronckers, A. L., Goei, W., van Heerde, W. L., Dumont, E. A., Reutelingsperger, C. P. und van den Eijnde, S. M.** (2000). Phagocytosis of dying chondrocytes by osteoclasts in the mouse growth plate as demonstrated by annexin-V labelling. *Cell Tissue Res* 301, 267-272.
- Bumcrot, D. A., Takada, R. und McMahon, A. P.** (1995). Proteolytic processing yields two secreted forms of sonic hedgehog. *Mol Cell Biol* 15, 2294-2303.
- Burke, R., Nellen, D., Bellotto, M., Hafen, E., Senti, K. A., Dickson, B. J. und Basler, K.** (1999). Dispatched, a novel sterol-sensing domain protein dedicated to the release of cholesterol-modified hedgehog from signaling cells. *Cell* 99, 803-815.
- Chegini, N.** (1997). The role of growth factors in peritoneal healing: transforming growth factor beta (TGF-beta). *Eur J Surg Suppl*, 17-23.
- Chen, J. K., Taipale, J., Cooper, M. K. und Beachy, P. A.** (2002a). Inhibition of Hedgehog signaling by direct binding of cyclopamine to Smoothened. *Genes Dev* 10, 2743-2748.
- Chen, J. K., Taipale, J., Young, K. E., Maiti, T. und Beachy, P. A.** (2002b). Small molecule modulation of Smoothened activity. *Proc Natl Acad Sci U S A* 99, 14071-14076.
- Chen, J. M., Dando, P. M., Rawlings, N. D., Brown, M. A., Young, N. E., Stevens, R. A., Hewitt, E., Watts, C. und Barrett, A. J.** (1997). Cloning, isolation, and characterization of mammalian legumain, an asparaginyl endopeptidase. *J Biol Chem* 272, 8090-8098.
- Chen, J. M., Dando, P. M., Stevens, R. A., Fortunato, M. und Barrett, A. J.** (1998). Cloning and expression of mouse legumain, a lysosomal endopeptidase. *Biochem J* 335, 111-117.

- Chen, J. M., Fortunato, M., Stevens, R. E. und Barrett, A. J.** (2001). Activation of progelatinase A by mammalian legumain, a recently rediscovered cysteine proteinase. *Biol Chem* 382, 777-783.
- Chen, Y. und Struhl, G.** (1996). Dual roles for patched in sequestering and transducing Hedgehog. *Cell* 87, 553-563.
- Chen, Y. und Struhl, G.** (1998). In vivo evidence that Patched and Smoothed constitute distinct binding and transducing components of a Hedgehog receptor complex. *Development* 125, 4943-4948.
- Chiang, C., Litingtung, Y., Lee, E., Young, K. E., Corden, J. L., Westphal, H. und Beachy, P. A.** (1996). Cyclopia and defective axial patterning in mice lacking Sonic hedgehog gene function. *Nature* 383, 407-413.
- Chiang, C., Swan, R. Z., Grachtchouk, M., Bolinger, M., Litingtung, Y., Robertson, E. K., Cooper, M. K., Gaffield, W., Westphal, H., Beachy, P. A. und Dlugosz, A. A.** (1999). Essential role for Sonic hedgehog during hair follicle morphogenesis. *Dev Biol* 205, 1-9.
- Choi, S. J., Reddy, S. V., Devlin, R. D., Mena, C., Chung, H., Boyce, B. F. und Roodman, G. D.** (1999). Identification of human asparaginyl endopeptidase (legumain) as an inhibitor of osteoclast formation and bone resorption. *J Biol Chem* 274, 27747-27753.
- Christopoulos, A. und Kenakin, T.** (2002). G protein-coupled receptor allostereism and complexing. *Pharmacol Rev* 54, 323-374.
- Chuang, P. T. und Kornberg, T. B.** (2000). On the range of hedgehog signaling. *Curr Opin Genet Dev* 10, 515-522.
- Chuang, P. T. und McMahon, A. P.** (1999). Vertebrate Hedgehog signalling modulated by induction of a Hedgehog-binding protein. *Nature* 397, 617-621.
- Chung, U. I., Schipani, E., McMahon, A. P. und Kronenberg, H. M.** (2001). Indian hedgehog couples chondrogenesis to osteogenesis in endochondral bone development. *J Clin Invest* 107, 295-304.
- Cooper, M. K., Porter, J. A., Young, K. E. und Beachy, P. A.** (1998). Teratogen-mediated inhibition of target tissue response to Shh signaling. *Science* 280, 1603-1607.

- Dahmane, N., Sanchez, P., Gitton, Y., Palma, V., Sun, T., Beyna, M., Weiner, H. und Ruiz i Altaba, A.** (2001). The Sonic Hedgehog-Gli pathway regulates dorsal brain growth and tumorigenesis. *Development* 128, 5201-5212.
- Dai, P., Akimaru, H., Tanaka, Y., Maekawa, T., Nakafuku, M. und Ishii, S.** (1999). Sonic Hedgehog-induced activation of the Gli1 promoter is mediated by GLI3. *J Biol Chem* 274, 8143-8152.
- Delattre, M., Briand, S., Paces-Fessy, M. und Blanchet-Tournier, M. F.** (1999). The Suppressor of fused gene, involved in Hedgehog signal transduction in *Drosophila*, is conserved in mammals. *Dev Genes Evol* 209, 294-300.
- Diatchenko, L., Lau, Y. F., Campbell, A. P., Chenchik, A., Moqadam, F., Huang, B., Lukyanov, S., Lukyanov, K., Gurskaya, N., Sverdlov, E. D. und Siebert, P. D.** (1996). Suppression subtractive hybridization: a method for generating differentially regulated or tissue-specific cDNA probes and libraries. *Proc Natl Acad Sci U S A* 93, 6025-6030.
- Diatchenko, L., Lukyanov, S., Lau, Y. F. und Siebert, P. D.** (1999). Suppression subtractive hybridization: a versatile method for identifying differentially expressed genes. *Methods Enzymol* 303, 349-380.
- Ducy, P., Zhang, R., Geoffroy, V., Ridall, A. L. und Karsenty, G.** (1997). *Osf2/Cbfa1*: a transcriptional activator of osteoblast differentiation. *Cell* 89, 747-754
- Duguid, J. R. und Dinauer, M. C.** (1990). Library subtraction of in vitro cDNA libraries to identify differentially expressed genes in scrapie infection. *Nucleic Acids Res* 18, 2789-2792.
- Dunn, M. K., Mercola, M. und Moore, D. D.** (1995). Cyclopamine, a steroidal alkaloid, disrupts development of cranial neural crest cells in *Xenopus*. *Dev Dyn* 202, 255-270.
- Echelard, Y., Epstein, D. J., St-Jacques, B., Shen, L., Mohler, J., McMahon, J. A. und McMahon, A. P.** (1993). Sonic hedgehog, a member of a family of putative signaling molecules, is implicated in the regulation of CNS polarity. *Cell* 75, 1417-1430.
- Egle, A., Villunger, A., Kos, M., Bock, G., Gruber, J., Auer, B. und Greil, R.** (1996). Modulation of Apo-1/Fas (CD95)-induced programmed cell death in myeloma cells by interferon-alpha 2. *Eur J Immunol* 26, 3119-3126.

- Ekker, S. C., Ungar, A. R., Greenstein, P., von Kessler, D. P., Porter, J. A., Moon, R. T. und Beachy, P. A.** (1995). Patterning activities of vertebrate hedgehog proteins in the developing eye and brain. *Curr Biol* 5, 944-955.
- Ericson, J., Morton, S., Kawakami, A., Roelink, H. und Jessell, T. M.** (1996). Two critical periods of Sonic Hedgehog signaling required for the specification of motor neuron identity. *Cell* 87, 661-673.
- Erlebacher, A., Filvaroff, E. H., Gitelman, S. E. und Derynck, R.** (1995). Toward a molecular understanding of skeletal development. *Cell* 80, 371-378.
- Fan, H., Oro, A. E., Scott, M. P. und Khavari, P. A.** (1997). Induction of basal cell carcinoma features in transgenic human skin expressing Sonic Hedgehog. *Nat Med* 3, 788-792.
- Ferguson, C., Alpern, E., Miclau, T. und Helms, J. A.** (1999). Does adult fracture repair recapitulate embryonic skeletal formation? *Mech Dev* 87, 57-66.
- Ferguson, C. M., Miclau, T., Hu, D., Alpern, E. und Helms, J. A.** (1998). Common molecular pathways in skeletal morphogenesis and repair. *Ann N Y Acad Sci* 857, 33-42.
- Fini, M. E., Girard, M. T. und Matsubara, M.** (1992). Collagenolytic/gelatinolytic enzymes in corneal wound healing. *Acta Ophthalmol Suppl*, 26-33.
- Garcia Abreu, J., Coffinier, C., Larrain, J., Oelgeschlager, M. und De Robertis, E. M.** (2002). Chordin-like CR domains and the regulation of evolutionarily conserved extracellular signaling systems. *Gene* 287, 39-47.
- Gilbert, S. F.** (2000). *Developmental Biology* (Sunderland, Sinauer Associates Inc.).
- Goetz, J. A., Suber, L. M., Zeng, X. und Robbins, D. J.** (2002). Sonic Hedgehog as a mediator of long-range signaling. *Bioessays* 24, 157-165.
- Goodrich, L. V., Jung, D., Higgins, K. M. und Scott, M. P.** (1999). Overexpression of *ptc1* inhibits induction of Shh target genes and prevents normal patterning in the neural tube. *Dev Biol* 211, 323-334.
- Graf, D., Timmons, P. M., Hitchins, M., Episkopou, V., Moore, G., Ito, T., Fujiyama, A., Fisher, A. G. und Merckenschlager, M.** (2001). Evolutionary conservation, developmental expression, and genomic mapping of mammalian Twisted gastrulation. *Mamm Genome* 12, 554-560.

- Gritli-Linde, A., Lewis, P., McMahon, A. P. und Linde, A.** (2001). The whereabouts of a morphogen: direct evidence for short- and graded long-range activity of hedgehog signaling peptides. *Dev Biol* 236, 364-386.
- Gurskaya, N. G., Diatchenko, L., Chenchik, A., Siebert, P. D., Khaspekov, G. L., Lukyanov, K. A., Vagner, L. L., Ermolaeva, O. D., Lukyanov, S. A. und Sverdlov, E. D.** (1996). Equalizing cDNA subtraction based on selective suppression of polymerase chain reaction: cloning of Jurkat cell transcripts induced by phytohemagglutinin and phorbol 12-myristate 13-acetate. *Anal Biochem* 240, 90-97.
- Gustafsson, M. K., Pan, H., Pinney, D. F., Liu, Y., Lewandowski, A., Epstein, D. J. und Emerson, C. P., Jr.** (2002). Myf5 is a direct target of long-range Shh signaling and Gli regulation for muscle specification. *Genes Dev* 16, 114-126.
- Haas, S. A., Beissbarth, T., Rivals, E., Krause, A. und Vingron, M.** (2000). GeneNest: automated generation and visualization of gene indices. *Trends Genet* 16, 521-523.
- Hahn, H., Christiansen, J., Wicking, C., Zaphiropoulos, P. G., Chidambaram, A., Gerrard, B., Vorechovsky, I., Bale, A. E., Toftgard, R., Dean, M. und Wainwright, B.** (1996). A mammalian patched homolog is expressed in target tissues of sonic hedgehog and maps to a region associated with developmental abnormalities. *J Biol Chem* 271, 12125-12128.
- Hall, B. K. und Miyake, T.** (2000a). All for one and one for all: condensations and the initiation of skeletal development. *Bioessays* 22, 138-147.
- Hall, B. K. und Miyake, T.** (2000b). Craniofacial development of avian and rodent embryos. *Methods Mol Biol* 135, 127-137.
- Hall, T. M., Porter, J. A., Young, K. E., Koonin, E. V., Beachy, P. A. und Leahy, D. J.** (1997). Crystal structure of a Hedgehog autoprocessing domain: homology between Hedgehog and self-splicing proteins. *Cell* 91, 85-97.
- Hamburger, V. und Hamilton, H. L.** (1951). A series of normal stages in the development of the chick embryo. *J Morphol* 88, 49-92.
- Hammerschmidt, M., Brook, A. und McMahon, A. P.** (1997). The world according to hedgehog. *Trends Genet* 13, 14-21.

- Hinchcliffe, J. R. und Johnson, D. R.** (1980). The development of the Vertebrate Limb (New York, Oxford University Press).
- Horton, W. E., Jr., Feng, L. und Adams, C.** (1998). Chondrocyte apoptosis in development, aging and disease. *Matrix Biol* 17, 107-115.
- Incardona, J. P., Gaffield, W., Kapur, R. P. und Roelink, H.** (1998). The teratogenic Veratrum alkaloid cyclopamine inhibits sonic hedgehog signal transduction. *Development* 125, 3553-3562.
- Incardona, J. P., Gaffield, W., Lange, Y., Cooney, A., Pentchev, P. G., Liu, S., Watson, J. A., Kapur, R. P. und Roelink, H.** (2000a). Cyclopamine inhibition of Sonic hedgehog signal transduction is not mediated through effects on cholesterol transport. *Dev Biol* 224, 440-452.
- Incardona, J. P., Lee, J. H., Robertson, C. P., Enga, K., Kapur, R. P. und Roelink, H.** (2000b). Receptor-mediated endocytosis of soluble and membrane-tethered Sonic hedgehog by Patched-1. *Proc Natl Acad Sci U S A* 97, 12044-12049.
- Incardona, J. P. und Roelink, H.** (2000). The role of cholesterol in Shh signaling and teratogen-induced holoprosencephaly. *Cell Mol Life Sci* 57, 1709-1719.
- Ingram, W. J., Wicking, C. A., Grimmond, S. M., Forrest, A. R. und Wainwright, B. J.** (2002). Novel genes regulated by Sonic Hedgehog in pluripotent mesenchymal cells. *Oncogene* 21, 8196-8205.
- Iwasaki, M., Le, A. X. und Helms, J. A.** (1997). Expression of indian hedgehog, bone morphogenetic protein 6 and gli during skeletal morphogenesis. *Mech Dev* 69, 197-202.
- James, B.D. und Higgins, S.J.** (1985). *Nucleic Acid Hybridization* (Oxford, IRL Press Ltd.).
- Johnson, R. L. und Scott, M. P.** (1998). New players and puzzles in the Hedgehog signaling pathway. *Curr Opin Genet Dev* 8, 450-456.
- Karp, S. J., Schipani, E., St-Jacques, B., Hunzelman, J., Kronenberg, H. und McMahon, A. P.** (2000). Indian hedgehog coordinates endochondral bone growth and morphogenesis via parathyroid hormone related-protein-dependent and -independent pathways. *Development* 127, 543-548.

- Kato, M., Seki, N., Sugano, S., Hashimoto, K., Masuho, Y., Muramatsu, M., Kaibuchi, K. und Nakafuku, M.** (2001). Identification of sonic hedgehog-responsive genes using cDNA microarray. *Biochem Biophys Res Commun* 289, 472-478.
- Kawakami, T., Kawcak, T., Li, Y. J., Zhang, W., Hu, Y. und Chuang, P. T.** (2002). Mouse dispatched mutants fail to distribute hedgehog proteins and are defective in hedgehog signaling. *Development* 129, 5753-5765.
- Keeler, R. F.** (1970). Teratogenic compounds of *Veratrum californicum* (Durand) X. Cyclopia in rabbits produced by cyclopamine. *Teratology* 3, 175-180.
- Keeler, R. F.** (1973a). Comparison of the teratogenicity in rats of certain potato-type alkaloids and the veratrum teratogen cyclopamine. *Lancet* 1, 1187-1188.
- Keeler, R. F.** (1973b). Teratogenic compounds of *Veratrum californicum* (Durand). XIV. Limb deformities produced by cyclopamine. *Proc Soc Exp Biol Med* 142, 1287-1291.
- Keeler, R. F.** (1975). Teratogenic effects of cyclopamine and jervine in rats, mice and hamsters. *Proc Soc Exp Biol Med* 149, 302-306.
- Keeler, R. F.** (1978). Cyclopamine and related steroidal alkaloid teratogens: their occurrence, structural relationship, and biologic effects. *Lipids* 13, 708-715.
- Kim, I. S., Otto, F., Zabel, B. und Mundlos, S.** (1999). Regulation of chondrocyte differentiation by Cbfa1. *Mech Dev* 80, 159-170.
- Kim, S. K. und Melton, D. A.** (1998). Pancreas development is promoted by cyclopamine, a hedgehog signaling inhibitor. *Proc Natl Acad Sci U S A* 95, 13036-13041.
- Kluppel, M., Vallis, K. A. und Wrana, J. L.** (2002). A high-throughput induction gene trap approach defines C4ST as a target of BMP signaling. *Mech Dev* 118, 77-89.
- Krause, A., Haas, S. A., Coward, E. und Vingron, M.** (2002). SYSTERS, GeneNest, SpliceNest: exploring sequence space from genome to protein. *Nucleic Acids Res* 30, 299-300.
- Kuang, W. W., Thompson, D. A., Hoch, R. V. und Weigel, R. J.** (1998). Differential screening and suppression subtractive hybridization identified genes

- differentially expressed in an estrogen receptor-positive breast carcinoma cell line. *Nucleic Acids Res* 26, 1116-1123.
- Laemmli, U. K.** (1970). Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature* 227, 680-685.
- Lanske, B., Karaplis, A. C., Lee, K., Luz, A., Vortkamp, A., Pirro, A., Karperien, M., Defize, L. H., Ho, C., Mulligan, R. C., Abou-Samra, A. B., Juppner, H., Segre, G. V. und Kronenberg, H. M.** (1996). PTH/PTHrP receptor in early development and Indian hedgehog-regulated bone growth. *Science* 273, 663-666.
- Leiner, I.E. und Friedenson B.** (1970). Ficin. *Meth Enzymol* 19, 261-273
- Liang, P., Averboukh, L. und Pardee, A. B.** (1993). Distribution and cloning of eukaryotic mRNAs by means of differential display: refinements and optimization. *Nucleic Acids Res* 21, 3269-3275.
- Liang, P. und Pardee, A. B.** (1992). Differential display of eukaryotic messenger RNA by means of the polymerase chain reaction. *Science* 257, 967-971.
- Lin, X., Wei, G., Shi, Z., Dryer, L., Esko, J. D., Wells, D. E. und Matzuk, M. M.** (2000). Disruption of gastrulation and heparan sulfate biosynthesis in EXT1-deficient mice. *Dev Biol* 224, 299-311.
- Lin, X. und Perrimon, N.** (2000). Role of heparan sulfate proteoglycans in cell-cell signaling in *Drosophila*. *Matrix Biol* 19, 303-307.
- Logan, M. und Tabin, C.** (1998). Targeted gene misexpression in chick limb buds using avian replication-competent retroviruses. *Methods* 14, 407-420.
- Long, F., Zhang, X. M., Karp, S., Yang, Y. und McMahon, A. P.** (2001). Genetic manipulation of hedgehog signaling in the endochondral skeleton reveals a direct role in the regulation of chondrocyte proliferation. *Development* 128, 5099-5108.
- Lopez-Martinez, A., Chang, D. T., Chiang, C., Porter, J. A., Ros, M. A., Simandl, B. K., Beachy, P. A. und Fallon, J. F.** (1995). Limb-patterning activity and restricted posterior localization of the amino-terminal product of Sonic hedgehog cleavage. *Curr Biol* 5, 791-796.

- Ma, Y., Erkner, A., Gong, R., Yao, S., Taipale, J., Basler, K. und Beachy, P.** (2002). Hedgehog-Mediated Patterning of the Mammalian Embryo Requires Transporter-like Function of Dispatched. *Cell* 111, 63.
- Madden, T. L., Tatusov, R. L. und Zhang, J.** (1996). Applications of network BLAST server. *Methods Enzymol* 266, 131-141.
- Mahlapuu, M., Enerback, S. und Carlsson, P.** (2001). Haploinsufficiency of the forkhead gene *Foxf1*, a target for sonic hedgehog signaling, causes lung and foregut malformations. *Development* 128, 2397-2406.
- Manfioletti, G., Ruaro, M. E., Del Sal, G., Philipson, L., Schneider, C.** (1990). A growth arrest-specific (gas) gene codes for a membrane protein. *Molec. Cell. Biol.* 10, 2924-2930.
- Mann, R. K. und Beachy, P. A.** (2000). Cholesterol modification of proteins. *Biochim Biophys Acta* 1529, 188-202.
- Manoury, B., Hewitt, E. W., Morrice N., Dando, P. M., Barrett, A. J. und Watts, C.** (1998). An asparaginyl endopeptidase processes a microbial antigen for class II MHC presentation. *Nature* 396, 695-699.
- Mariani, M., Camagna, M., Tarditi, L. und Seccamani, E.** (1991). A new enzymatic method to obtain high-yield $F(ab')_2$ suitable for clinical use from mouse IgG1. *Mol Immunol* 28, 69-77.
- Marigo, V., Davey, R. A., Zuo, Y., Cunningham, J. M. und Tabin, C. J.** (1996a). Biochemical evidence that patched is the Hedgehog receptor. *Nature* 384, 176-179.
- Marigo, V., Johnson, R. L., Vortkamp, A. und Tabin, C. J.** (1996b). Sonic hedgehog differentially regulates expression of *GLI* and *GLI3* during limb development. *Dev Biol* 180, 273-283.
- Marigo, V., Laufer, E., Nelson, C. E., Riddle, R. D., Johnson, R. L. und Tabin, C.** (1996c). Sonic hedgehog regulates patterning in early embryos. *Biochem Soc Symp* 62, 51-60.
- Marigo, V., Roberts, D. J., Lee, S. M., Tsukurov, O., Levi, T., Gastier, J. M., Epstein, D. J., Gilbert, D. J., Copeland, N. G., und Seidman, C. E.** (1995). Cloning, expression, and chromosomal location of *SHH* and *IHH*: two human

- homologues of the *Drosophila* segment polarity gene hedgehog. *Genomics* 28, 44-51.
- Marigo, V. und Tabin, C. J.** (1996). Regulation of patched by sonic hedgehog in the developing neural tube. *Proc Natl Acad Sci U S A* 93, 9346-9351.
- McMahon, A. P.** (2000). More surprises in the Hedgehog signaling pathway. *Cell* 100, 185-188.
- Milenic, D.E., Esteban, J.M., Colcher, D.** (1989). Comparison of methods for the generation of immunoreactive fragments of a monoclonal antibody (B72.3) reactive with human carcinomas. *J Immunol Meth* 120, 71-83
- Minina, E., Kreschel, C., Naski, M., Ornitz, D. und Vortkamp, A.** (2002). Interaction of FGF, Ihh/Pthlh, and BMP Signaling Integrates Chondrocyte Proliferation and Hypertrophic Differentiation. *Dev Cell* 3, 439.
- Minina, E., Wenzel, H. M., Kreschel, C., Karp, S., Gaffield, W., McMahon, A. P. und Vortkamp, A.** (2001). BMP and Ihh/PTHrP signaling interact to coordinate chondrocyte proliferation and differentiation. *Development* 128, 4523-4534.
- Morgan, B. A. und Fekete, D. M.** (1996). Manipulating gene expression with replication-competent retroviruses. *Methods Cell Biol* 51, 185-218.
- Mullis, K., Faloona, F., Scharf, S., Saiki, R., Horn, G. und Erlich, H.** (1986). Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. *Cold Spring Harb Symp Quant Biol* 51, 263-273.
- Mullis, K. B. und Faloona, F. A.** (1987). Specific synthesis of DNA in vitro via a polymerase-catalyzed chain reaction. *Methods Enzymol* 155, 335-350.
- Murone, M., Rosenthal, A. und de Sauvage, F. J.** (1999a). Hedgehog signal transduction: from flies to vertebrates. *Exp Cell Res* 253, 25-33.
- Murone, M., Rosenthal, A. und de Sauvage, F. J.** (1999b). Sonic hedgehog signaling by the patched-smoothed receptor complex. *Curr Biol* 9, 76-84.
- Nakashima, K., Zhou, X., Kunkel, G., Zhang, Z., Deng, J. M., Behringer, R. R. und de Crombrughe, B.** (2002). The novel zinc finger-containing transcription factor osterix is required for osteoblast differentiation and bone formation. *Cell* 108, 17-29

- Nüsslein-Volhard, C. und Wieschaus, E.** (1980). Mutations affecting segment number and polarity in *Drosophila*. *Nature* 287, 795-801.
- Oldak, M., Grzela, T., Lazarczyk, M., Malejczyk, J. und Skopinski, P.** (2001). Clinical aspects of disrupted Hedgehog signaling (Review). *Int J Mol Med* 8, 445-452.
- Outram, S. V., Varas, A., Pepicelli, C. V. und Crompton, T.** (2000). Hedgehog signaling regulates differentiation from double-negative to double-positive thymocyte. *Immunity* 13, 187-197.
- Park, H. L., Bai, C., Platt, K. A., Matise, M. P., Beeghly, A., Hui, C. C., Nakashima, M. und Joyner, A. L.** (2000). Mouse *Gli1* mutants are viable but have defects in SHH signaling in combination with a *Gli2* mutation. *Development* 127, 1593-1605.
- Parmantier, E., Lynn, B., Lawson, D., Turmaine, M., Namini, S. S., Chakrabarti, L., McMahon, A. P., Jessen, K. R. und Mirsky, R.** (1999). Schwann cell-derived Desert hedgehog controls the development of peripheral nerve sheaths. *Neuron* 23, 713-724.
- Pathi, S., Rutenberg, J. B., Johnson, R. L. und Vortkamp, A.** (1999). Interaction of *Ihh* and BMP/Noggin signaling during cartilage differentiation. *Dev Biol* 209, 239-253.
- Pearse, R. V., 2nd, Vogan, K. J. und Tabin, C. J.** (2001). *Ptc1* and *Ptc2* transcripts provide distinct readouts of Hedgehog signaling activity during chick embryogenesis. *Dev Biol* 239, 15-29.
- Pietu, G., Alibert, O., Guichard, V., Lamy, B., Bois, F., Leroy, E., Mariage-Sampson, R., Houlgatte, R., Soularue, P. und Auffray, C.** (1996). Novel gene transcripts preferentially expressed in human muscles revealed by quantitative hybridization of a high density cDNA array. *Genome Res* 6, 492-503.
- Porter, J. A., Ekker, S. C., Park, W. J., von Kessler, D. P., Young, K. E., Chen, C. H., Ma, Y., Woods, A. S., Cotter, R. J., Koonin, E. V. und Beachy, P. A.** (1996a). Hedgehog patterning activity: role of a lipophilic modification mediated by the carboxy-terminal autoprocessing domain. *Cell* 86, 21-34.
- Porter, J. A., Young, K. E. und Beachy, P. A.** (1996b). Cholesterol modification of hedgehog signaling proteins in animal development. *Science* 274, 255-259.

- Reddi, A. H.** (2001). Interplay between bone morphogenetic proteins and cognate binding proteins in bone and cartilage development: noggin, chordin and DAN. *Arthritis Res* 3, 1-5.
- Reifenberger, J., Wolter, M., Weber, R. G., Megahed, M., Ruzicka, T., Lichter, P. und Reifenberger, G.** (1998). Missense mutations in SMOH in sporadic basal cell carcinomas of the skin and primitive neuroectodermal tumors of the central nervous system. *Cancer Res* 58, 1798-1803.
- Roessler, E., Belloni, E., Gaudenz, K., Jay, P., Berta, P., Scherer, S. W., Tsui, L. C. und Muenke, M.** (1996). Mutations in the human Sonic Hedgehog gene cause holoprosencephaly. *Nat Genet* 14, 357-360.
- Ross, J. J., Shimmi, O., Vilmos, P., Petryk, A., Kim, H., Gaudenz, K., Hermanson, S., Ekker, S. C., O'Connor, M. B. und Marsh, J. L.** (2001). Twisted gastrulation is a conserved extracellular BMP antagonist. *Nature* 410, 479-483.
- Rowitch, D. H., B, S. J., Lee, S. M., Flax, J. D., Snyder, E. Y. und McMahon, A. P.** (1999). Sonic hedgehog regulates proliferation and inhibits differentiation of CNS precursor cells. *J Neurosci* 19, 8954-8965.
- Ruiz i Altaba, A.** (1999a). Gli proteins and Hedgehog signaling: development and cancer. *Trends Genet* 15, 418-425.
- Ruiz i Altaba, A.** (1999b). Gli proteins encode context-dependent positive and negative functions: implications for development and disease. *Development* 126, 3205-3216.
- Saiki, R. K., Scharf, S., Faloona, F., Mullis, K. B., Horn, G. T., Erlich, H. A. und Arnheim, N.** (1985). Enzymatic amplification of beta-globin genomic sequences and restriction site analysis for diagnosis of sickle cell anemia. *Science* 230, 1350-1354.
- Sambrook, J., Fritsch, E. F. und Maniatis, T.** (1989). *Molecular cloning: a laboratory manual* (New York, Cold Spring Harbor Laboratory Press).
- Sargent, T. D. und Dawid, I. B.** (1983). Differential gene expression in the gastrula of *Xenopus laevis*. *Science* 222, 135-139.

- Schipani, E., Kruse, K. und Juppner, H.** (1995). A constitutively active mutant PTH-PTHrP receptor in Jansen-type metaphyseal chondrodysplasia. *Science* 268, 98-100.
- Schneider, C., King, R. M., Philipson, L.** (1988). Genes specifically expressed at growth arrest of mammalian cells. *Cell* 54, 787-793.
- Scott, I. C., Blitz, I. L., Pappano, W. N., Maas, S. A., Cho, K. W. und Greenspan, D. S.** (2001). Homologues of Twisted gastrulation are extracellular cofactors in antagonism of BMP signalling. *Nature* 410, 475-478.
- Shum, L. und Nuckolls, G.** (2002). The life cycle of chondrocytes in the developing skeleton. *Arthritis Res* 4, 94-106.
- Soares, M. B., Bonaldo, M. F., Jelene, P., Su, L., Lawton, L. und Efstratiadis, A.** (1994). Construction and characterization of a normalized cDNA library. *Proc Natl Acad Sci U S A* 91, 9228-9232.
- Southern, E. M.** (1975). Detection of specific sequences among DNA fragments separated by gel electrophoresis. *J Mol Biol* 98, 503-517.
- St-Jacques, B., Hammerschmidt, M. und McMahon, A. P.** (1999). Indian hedgehog signaling regulates proliferation and differentiation of chondrocytes and is essential for bone formation. *Genes Dev* 13, 2072-2086.
- Stickens, D., Brown, D. und Evans, G. A.** (2000). EXT genes are differentially expressed in bone and cartilage during mouse embryogenesis. *Dev Dyn* 218, 452-464.
- Strigini, M. und Cohen, S. M.** (1997). A Hedgehog activity gradient contributes to AP axial patterning of the *Drosophila* wing. *Development* 124, 4697-4705.
- Suda, N.** (1997). Parathyroid hormone-related protein (PTHrP) as a regulating factor of endochondral bone formation. *Oral Dis* 3, 229-231.
- Sukegawa, A., Narita, T., Kameda, T., Saitoh, K., Nohno, T., Iba, H., Yasugi, S. und Fukuda, K.** (2000). The concentric structure of the developing gut is regulated by Sonic hedgehog derived from endodermal epithelium. *Development* 127, 1971-1980.
- Suter, U. und Snipes, G. J.** (1995). Peripheral myelin protein 22: facts and hypotheses. *J Neurosci Res* 40, 145-151.

- Taipale, J., Cooper, M. K., Maiti, T. und Beachy, P. A.** (2002). Patched acts catalytically to suppress the activity of Smoothed. *Nature* 418, 892-897.
- Taylor, F. R., Wen, D., Garber, E. A., Carmillo, A. N., Baker, D. P., Arduini, R. M., Williams, K. P., Weinreb, P. H., Rayhorn, P., Hronowski, X., Galdes, A. und Pepinsky, R. B.** (2001). Enhanced potency of human Sonic hedgehog by hydrophobic modification. *Biochemistry* 40, 4359-4371.
- Tekki-Kessarlis, N., Woodruff, R., Hall, A. C., Gaffield, W., Kimura, S., Stiles, C. D., Rowitch, D. H. und Richardson, W. D.** (2001). Hedgehog-dependent oligodendrocyte lineage specification in the telencephalon. *Development* 128, 2545-2554.
- The, I., Bellaiche, Y. und Perrimon, N.** (1999). Hedgehog movement is regulated through tout velu-dependent synthesis of a heparan sulfate proteoglycan. *Mol Cell* 4, 633-639.
- Thomas, M. K., Rastalsky, N., Lee, J. H. und Habener, J. F.** (2000). Hedgehog signaling regulation of insulin production by pancreatic beta-cells. *Diabetes* 49, 2039-2047.
- Towbin, H., Staehelin, T. und Gordon, J.** (1979). Electrophoretic transfer of proteins from polyacrylamide gels to nitrocellulose sheets: procedure and some applications. *Proc Natl Acad Sci U S A* 76, 4350-4354.
- Venter, J. C., Adams, M. D., Myers, E. W., Li, P. W., Mural, R. J., Sutton, G. G., Smith, H. O., Yandell, M., Evans, C. A., Holt, R. A. et al.** (2001). The sequence of the human genome. *Science* 291, 1304-1351.
- Vortkamp, A., Lee, K., Lanske, B., Segre, G. V., Kronenberg, H. M. und Tabin, C. J.** (1996). Regulation of rate of cartilage differentiation by Indian hedgehog and PTH-related protein. *Science* 273, 613-622.
- Vortkamp, A., Pathi, S., Peretti, G. M., Caruso, E. M., Zaleske, D. J. und Tabin, C. J.** (1998). Recapitulation of signals regulating embryonic bone formation during postnatal growth and in fracture repair. *Mech Dev* 71, 65-76.
- Wilson, K. M., Gerometta, M., Rylatt, D. B., Bundesen, P. G., 1st, McPhee, D. A., Hillyard, C. J., Kemp, B. E. und Seccamani, E.** (1991). A new enzymatic method to obtain high-yield F(ab)₂ suitable for clinical use from mouse IgG1. *Mol Immunol* 28, 69-77

-
- Wong, B. R., Rho, J., Arron, J., Robinson, E., Orlinick, J., Chao, M., Kalachikov, S., Cayani, E., Bartlett, F. S., 3rd, Frankel, W. N., Lee, S. Y. und Choi, Y.** (1997). TRANCE is a novel ligand of the tumor necrosis factor receptor family that activates c-Jun N-terminal kinase in T cells. *J Biol Chem* 272, 25190-25194.
- Wright, F. A., Lemon, W. J., Zhao, W. D., Sears, R., Zhuo, D., Wang, J. P., Yang, H. Y., Baer, T., Stredney, D., Spitzner, J., Stutz, A., Krahe, R. und Yuan, B.** (2001). A draft annotation and overview of the human genome. *Genome Biol* 2, RESEARCH0025.
- Xie, J., Murone, M., Luoh, S. M., Ryan, A., Gu, Q., Zhang, C., Bonifas, J. M., Lam, C. W., Hynes, M., Goddard, A., Rosenthal, A., Epstein, E. H., Jr. und de Sauvage, F. J.** (1998). Activating Smoothed mutations in sporadic basal-cell carcinoma. *Nature* 391, 90-92.
- Yokomizo, T., Izumi, T., Chang, K., Takuwa, Y. und Shimizu, T.** (1997). A G-protein-coupled receptor for leukotriene B4 that mediates chemotaxis. *Nature* 387, 620-624.
- Yoon, J. W., Kita, Y., Frank, D. J., Majewski, R. R., Konicek, B. A., Nobrega, M. A., Jacob, H., Walterhouse, D. und Iannaccone, P.** (2002). Gene expression profiling leads to identification of GLI1-binding elements in target genes and a role for multiple downstream pathways in GLI1-induced cell transformation. *J Biol Chem* 277, 5548-5555.
- Zhang, X. M. und Yang, X. J.** (2001). Temporal and spatial effects of Sonic hedgehog signaling in chick eye morphogenesis. *Dev Biol* 233, 271-290.