Chapter 62
Inherited Epidemolysis Bullosa

M. Peter Marinkovich

REFERENCES

1. Hebra FV: *Arztlicher Bericht des K.K allegemeinen Krankenhauses zu Wien vom Jare 1870*. Vienna, Pemphigus, 1870, p. 362.
2. Fox T: Notes on unusual or rare forms of skin disease. *Lancet* ***1***:766, 1879
3. Goldscheider A: Hereditare Neigung zer Blasenbildung. *Monatsschr Prakt Dermatol* ***1***:163, 1882
4. Koebner H: Hereditare Anlage zur Blasenbildung. *Dtsch Med Wochenschr* ***12***:21, 1886
5. Hallopeau MH: Nouvelle etude sur la dermatite bulleuse congenitale avec kysts epidermiques. *Ann Dermatol Syphiligr (Paris)* ***7***:453, 1896
6. Weber FP: Recurrent bullous eruption on the feet in a child. *Proc R Soc Med* ***19***:72, 1926
7. Cockayne EA: Recurrent bullous eruption of feet. *Br J Dermatol* ***50***:358, 1938
8. Dowling GB: Epidermolysis bullosa resembling juvenile dermatitis herpetiformis. *Br J Dermatol* ***66***:139, 1954
9. Hoffman E: Uber den Erbgang bei Epidermolysis bullosa hereditaria. *Arch Rassen Gesellsch Biol* ***18***:353, 1926
10. Cockayne EA: *Inherited Abnormalities of the Skin and its Appendages*. London, Oxford University Press, 1933
11. Touraine MA: Classification des epidermolyses bulleuses. *Ann Dermatol Syphiligr (Paris)* ***2***:141, 1942
12. Pasini A: Dystrophie cutanee bulleuse atrophiante et albopapuloide. *Ann Dermatol Syphiligr (Paris)* ***9***:1044, 1928
13. Bart BJ, et al: Congenital localized absence of skin and associated abnormalities resembling epidermolysis bullosa. *Arch Dermatol* ***93***:293, 1966
14. Herlitz G: Kongenitaler, nicht syphilitischer Pemphigus: Eine Ubersicht nebst Beschreibung einer neuen Krankheitsform. *Acta Paediatr* ***7***:315, 1935
15. Pearson RW: Studies on the pathogenesis of epidermolysis bullosa. *J Invest Dermatol* ***39***:551-575, 1962
16. Gedde-Dahl T: *Epidermolysis Bullosa: A Clinical, Genetic and Epidemiologic Study*. Baltimore, The John Hopkins Press, 1971, pp. 1-180.
17. LeBleu VS, Macdonald B, Kalluri R: Structure and function of basement membranes. *Exp Biol Med (Maywood)* ***232***:1121-1129, 2007
18. Yoshida-Moriguchi T et al: O-mannosyl phosphorylation of alpha-dystroglycan is required for laminin binding. *Science* ***327***:88-92, 2010
19. Arin MJ: The molecular basis of human keratin disorders. *Hum Genet* ***125***:355-373, 2009
20. Coulombe PA, Kerns ML, Fuchs E, Epidermolysis bullosa simplex: A paradigm for disorders of tissue fragility. *J Clin Invest* ***119***:1784-1793, 2009
21. Rezniczek GA, Janda L, Wiche G: *Plectin. Methods Cell Biol* ***78***:721-755, 2004
22. Na S et al: Plectin contributes to mechanical properties of living cells. *Am J Physiol Cell Physiol* ***296***:C868-C877, 2009
23. Jefferson JJ et al: Structural analysis of the plakin domain of bullous pemphigoid antigen1 (BPAG1) suggests that plakins are members of the spectrin superfamily. *J Mol Biol* ***366***:244-257, 2007
24. Young KG, Kothary R: Dystonin/Bpag1 is a necessary endoplasmic reticulum/nuclear envelope protein in sensory neurons. *Exp Cell Res* ***314***:2750-2761, 2008
25. Young KG, Kothary R: Dystonin/Bpag1–A link to what? *Cell Motil Cytoskeleton* ***64***:897-905, 2007
26. Leung CL et al: The BPAG1 locus: Alternative splicing produces multiple isoforms with distinct cytoskeletal linker domains, including predominant isoforms in neurons and muscles. *J Cell Biol* ***154***:691-697, 2001
27. Has C, Kern JS: Collagen XVII. *Dermatol Clin* ***28***:61-66, 2010
28. Litjens S, de Pereda J, Sonnenberg A: Current insights into the formation and breakdown of hemidesmosomes. *Trends Cell Biol* ***16***:376-383, 2006
29. de Pereda JM, Lillo MP, Sonnenberg A: Structural basis of the interaction between integrin alpha-6beta4 and plectin at the hemidesmosomes. *EMBO J* ***28***:1180-1190, 2009

30. Dowling J, Yu QC, Fuchs E: Beta4 integrin is required for hemidesmosome formation, cell adhesion and cell survival. *J Cell Biol* ***134***:559-572, 1996

31. Margadant C et al: Regulation of hemidesmosome disassembly by growth factor receptors. *Curr Opin Cell Biol* ***20***(5):589-596, 2008

32. Hirako Y et al: Demonstration of the molecular shape of BP180, a 180-kDa bullous pemphigoid antigen and its potential for trimer formation. *J Biol Chem* ***271***:13739-13745, 1996

33. Carter WG et al: Distinct functions for integrins alpha 3 beta 1 in focal adhesions and alpha 6 beta 4/bullous pemphigoid antigen in a new stable anchoring contact (SAC) of keratinocytes: relation to hemidesmosomes. *J Cell Biol* ***111***:3141-3154, 1990

34. Zone JJ et al: Identification of the cutaneous basement membrane antigen in linear IgA bullous dermatosis. *J Clin Invest* ***85***:812-820, 1990

35. Marinkovich MP et al: LAD-1, the linear IgA bullous dermatosis autoantigen, is a novel 120- kDa anchoring filament protein synthesized by epidermal cells. *J Invest Dermatol* ***106***:734-738, 1996

36. Zone JJ et al: The 97 kDa linear IgA bullous disease antigen is identical to a portion of the extracellular domain of the 180 kDa bullous pemphigoid antigen, BPAg2. *J Invest Dermatol* ***110***:207-210, 1998

37. Franzke CW, Bruckner P, Bruckner-Tuderman L: Collagenous transmembrane proteins: Recent insights into biology and pathology. *J Biol Chem* ***280***:4005-4008, 2005

38. Franzke CW et al: Shedding of collagen XVII/BP180: Structural motifs influence cleavage from cell surface. *J Biol Chem* ***279***:24521-24529, 2004

39. Franzke CW et al: Transmembrane collagen XVII, an epithelial adhesion protein, is shed from the cell surface by ADAMs. *Embo J* ***21***:5026-5035, 2002

40. Durbeej M: Laminins. *Cell Tissue Res* ***339***:259-268, 2010

41. Miner JH: Laminins and their roles in mammals. *Microsc Res Tech* ***71***:349-356, 2008

42. Scheele S et al: Laminin isoforms in development and disease. *J Mol Med* ***85***:825-836, 2007

43. Rousselle P et al: Kalinin: An epithelium-specific basement membrane adhesion molecule that is a component of anchoring filaments. *J Cell Biol* ***114***: 567-576, 1991

44. Meneguzzi G et al: Kalinin is abnormally expressed in epithelial basement membranes of Herlitz's junctional epidermolysis bullosa patients. *Exp Dermatol* ***1***:221-229, 1992

45. Gerecke DR et al: The complete primary structure for a novel laminin chain, the laminin B1k chain. *J Biol Chem* ***269***:11073-11080, 1994

46. Ryan MC et al: Cloning of the LamA3 gene encoding the alpha 3 chain of the adhesive ligand epiligrin. Expression in wound repair. *J Biol Chem* ***269***:22779-22787, 1994

47. Kallunki P et al: A truncated laminin chain homologous to the B2 chain: Structure, spatial expression, and chromosomal assignment. *J Cell Biol* ***119***:679-693, 1992

48. Champliaud MF et al: Human amnion contains a novel laminin variant, laminin 7, which like laminin 6, covalently associates with laminin 5 to promote stable epithelial-stromal attachment. *J Cell Biol* ***132***:1189-1198, 1996

49. Marinkovich MP et al: The dermal-epidermal junction of human skin contains a novel laminin variant. *J Cell Biol* ***119***:695-703, 1992

50. Marinkovich M, LunstrumG, Burgeson R: The anchoring filament protein kalinin is synthesized and secreted as a high molecular weight precursor. *J Biol Chem* ***267***:17900-17906, 1992

51. Giannelli G et al: Induction of cell migration by matrix metalloprotease-2 cleavage of laminin-5. *Science* ***277***:225-228, 1997

52. Koshikawa N et al: Role of cell surface metalloprotease MT1-MMP in epithelial cell migration over laminin-5. *J Cell Biol* ***148***:615-624, 2000

53. Veitch DP et al: Mammalian tolloid metalloproteinase, and not matrix metalloprotease 2 or membrane type 1 metalloprotease, processes laminin-5 in keratinocytes and skin. *J Biol Chem* ***278***:15661-15668, 2003

54. Ge G, Greenspan D: Developmental roles of the BMP1/TLD metalloproteinases. *Birth Defects Res C Embryo Today* ***78***:47-68, 2006

55. Amano S et al: Bone morphogenetic protein 1 is an extracellular processing enzyme of the laminin 5 gamma 2 chain. *J Biol Chem* ***275***:22728-22735, 2000

56. Goldfinger LE et al: The a3 laminin subunit, a6b4 and a3b1 integrin coordinately regulate wound healing in cultured epithelial cells and in the skin. *J Cell Sci* ***112***:2615-2629, 1999

57. Gagnoux-Palacios L et al: The short arm of the laminin gamma2 chain plays a pivotal role in the incorporation of laminin 5 into the extracellular matrix and in cell adhesion. *J Cell Biol* ***153***:835-850, 2001

58. Fine JD, Horiguchi Y, Couchman JR: 19-DEJ-1, a hemidesmosome-anchoring filament complex associated monoclonal antibody. Definition of a new skin basement membrane antigenic defect in junctional and dystrophic epidermolysis bullosa. *Arch Dermatol* ***125***:520-523, 1989

59. Parente MG et al: Human type VII collagen: cDNA cloning and chromosomal mapping of the gene (COL7A1) on chromosome 3 to dominant dystrophic epidermolysis bullosa. *Am J Hum Genet* ***24***:119-135, 1991

60. Burgeson RE, Lundstrum GP, Rokosova B: The structure and function of type VII collagen. *Ann N Y Acad Sci* ***580***:32-43, 1990

61. Bachinger HP et al: The relationship of the biophysical and biochemical characteristics of type VII collagen to the function of anchoring fibrils. *J Biol Chem* ***265***:10095-10101, 1990

62. Bruckner-Tuderman L, Hopfner B, Hammami-Hauasli N: Biology of anchoring fibrils: Lessons from dystrophic epidermolysis bullosa. *Matrix Biol* ***18***:43-54, 1999

63. Gayraud B et al: Characterization of a 50-kDa component of epithelial basement membranes using GDA-J/F3 monoclonal antibody. *J Biol Chem* ***272***:9531-9538, 1997

64. Chen M et al: NC1 domain of type VII collagen binds to the beta3 chain of laminin 5 via a unique subdomain within the fibronectin-like repeats. *J Invest Dermatol* ***112***:177-83, 1999

65. Rousselle P et al: Laminin 5 binds the NC-1 domain of type VII collagen. *J Cell Biol* ***138***:719-28, 1997

66. Nakashima Y et al: Regulation of cell adhesion and type VII collagen binding by the beta3 chain short arm of laminin-5: effect of its proteolytic cleavage. *J Biochem (Tokyo)* ***138***:539-552, 2005

67. Waterman EA et al: A laminin-collagen complex drives human epidermal carcinogenesis through phosphoinositol-3-kinase activation. *Cancer Res* ***67***:4264-4270, 2007

68. Ortiz-Urda S et al: Type VII collagen is required for Ras-driven human epidermal tumorigenesis. *Science* ***307***:1773-1776, 2005

69. Chen M et al: The carboxyl terminus of type VII collagen mediates antiparallel-dimer formation and constitutes a new antigenic epitope for EBA autoantibodies. *J Biol Chem* ***27***:27, 2001

70. Smith LT: Ultrastructural findings in epidermolysis bullosa. *Arch Dermatol* ***129***:1578-1584, 1993

71. Fine JD et al: The classification of inherited epidermolysis bullosa (EB): Report of the Third International Consensus Meeting on Diagnosis and Classification of EB. *J Am Acad Dermatol* ***58***:931-50, 2008

72. Sprecher E: Epidermolysis bullosa simplex. *Dermatol Clin* ***28***:23-32, 2010

73. Morrell D.S et al: Congenital pyloric atresia in a newborn with extensive aplasia cutis congenita and epidermolysis bullosa simplex. *Br J Dermatol* ***143***:1342-1343, 2000

74. Shemanko CS et al: Laryngeal involvement in the Dowling-Meara variant of epidermolysis bullosa simplex with keratin mutations of severely disruptive potential. *Br J Dermatol* ***142***:315-320, 2000

75. Chavanas S et al: A homozygous nonsense mutation in the PLEC1 gene in patients with epidermolysis bullosa simplex with muscular dystrophy. *J Clin Invest* ***98***:2196-200, 1996

76. Gache Y et al: Defective expression of plectin/HD1 in epidermolysis bullosa simplex with muscular dystrophy. *J Clin Invest* ***97***:2289-2298, 1996

77. McLean WH et al: Loss of plectin causes epidermolysis bullosa with muscular dystrophy: cDNA cloning and genomic organization. *Genes Dev* ***10***:1724-1735, 1996

78. Dang M et al: Novel compound heterozygous mutations in the plectin gene in epidermolysis bullosa with muscular dystrophy and the use of protein truncation test for detection of premature termination codon mutations. *Lab Invest* ***78***:195-204, 1998

79. Bauer JW et al: Large melanocytic nevi in hereditary epidermolysis bullosa. *J Am Acad Dermatol* ***44***:577-84, 2001

80. Fine JD, Johnson L, Wright T: Epidermolysis bullosa simplex superficialis. *Arch Dermatol* ***125***:633-638, 1989

81. McGrath JA, Bolling MC,Jonkman MF: Lethal acantholytic epidermolysis bullosa. *Dermatol Clin* ***28***:131-135, 2010

82. McGrath J: Hereditary diseases of desmosomes. *J Dermatol Sci* ***20***:85-91, 1999

83. Hovnanian A, Duquesnoy P, Amselem S: Genetic linkage of recessive epidermolysis bullosa to the type VII collagen gene. *J Clin Invest* ***90***:1033-1037, 1992

84. Jonkman MF et al: Effects of keratin 14 ablation on the clinical and cellular phenotype in a kindred with recessive epidermolysis bullosa simplex. *J Invest Dermatol* ***107***:764-769, 1996

85. Coulombe PA: The cellular and molecular biology of keratins: Beginning a new era. *Curr Opin Cell Biol* ***5***:17-29, 1993

86. Uttam J et al: The genetic basis of epidermolysis bullosa simplex with mottled pigmentation. *Proc Natl Acad Sci USA* ***93***:9079-9084, 1996

87. Irvine AD et al: Molecular confirmation of the unique phenotype of epidermolysis bullosa simplex with mottled pigmentation. *Br J Dermatol* ***144***:40-45, 2001

88. Moog U et al: Epidermolysis bullosa simplex with mottled pigmentation: Clinical aspects and confirmation of the P24L mutation in the KRT5 gene in further patients. *Am J Med Genet* ***86***:376-379, 1999

89. Chamcheu JC et al: Epidermolysis bullosa simplex due to KRT5 mutations: Mutation-related differences in cellular fragility and the protective effects of trimethylamine N-oxide in cultured primary keratinocytes. *Br J Dermatol* ***162***:980-989, 2010

90. Rezniczek GA, Walko G, Wiche G: Plectin gene defects lead to various forms of epidermolysis bullosa simplex. *Dermatol Clin* ***28***:33-41, 2010

91. Konieczny P, Wiche G: Muscular integrity–A matter of interlinking distinct structures via plectin. *Adv Exp Med Biol* ***642***:165-175, 2008

92. Natsuga K et al: Plectin deficiency leads to both muscular dystrophy and pyloric atresia in epidermolysis bullosa simplex. *Hum Mutat* ***31***(10):E1687-E1698, 2010

93. Groves RW et al: A homozygous nonsense mutation within the dystonin gene coding for the coiled-coil domain of the epithelial isoform of BPAG1 underlies a new subtype of autosomal recessive epidermolysis bullosa simplex. *J Invest Dermatol* ***130***:1551-1557, 2010

94. McGrath J et al: Skin fragility and hypohidrotic ectodermal dysplasia resulting from ablation of plakophilin 1. *Br J Dermatol* ***140***:297-307, 1999

95. Fassihi H et al: Preimplantation genetic diagnosis of skin fragility-ectodermal dysplasia syndrome. *Br J Dermatol* ***154***:546-550, 2006

96. Ersoy-Evans S et al: Ectodermal dysplasia-skin fragility syndrome resulting from a new homozygous mutation, 888delC, in the desmosomal protein plakophilin 1. *J Am Acad Dermatol* ***55***:157-161, 2006

97. Wessagowit V, McGrath J: Clinical and molecular significance of splice site mutations in the plakophilin 1 gene in patients with ectodermal dysplasia-skin fragility syndrome. *Acta Derm Venereol* ***85***:386-388, 2005

98. Hamada T et al: Genotype-phenotype correlation in skin fragility-ectodermal dysplasia syndrome resulting from mutations in plakophilin 1. *Exp Dermatol* ***11***:107-114, 2002

99. Whittock N et al: Genomic amplification of the human plakophilin 1 gene and detection of a new mutation in ectodermal dysplasia/skin fragility syndrome. *J Invest Dermatol* ***115***:368-374, 2000

100. McGrath J: A novel genodermatosis caused by mutations in plakophilin 1, a structural component of desmosomes. *J Dermatol* ***26***:764-769, 1999

101. Fattah A: Epidermolysis bullosa hereditaria letalis (Herlitz). *Dermatologica* ***133***:475-481, 1966

102. Laimer M et al: Herlitz junctional epidermolysis bullosa. *Dermatol Clin* ***28***:55-60, 2010

103. McLean WH et al: An unusual N-terminal deletion of the laminin alpha3a isoform leads to the chronic granulation tissue disorder laryngo-onycho-cutaneous syndrome. *Hum Mol Genet* ***12***:2395-2409, 2003

104. Sakai N et al: Observations of skin grafts derived from keratinocytes expressing selectively engineered mutant laminin-332 molecules. *J Invest Dermatol* ***130***:2147-2150, 2010.

105. Hintner H, Wolff K: Generalized atrophic benign epidermolysis bullosa. *Arch Dermatol* ***118***:375-384, 1982

106. Vidal F et al: Integrin beta 4 mutations associated with junctional epidermolysis bullosa with pyloric atresia. *Nat Genet* ***10***:229-234, 1995

107. Inoue, M et al: A homozygous missense mutation in the cytoplasmic tail of beta4 integrin, G931D, that disrupts hemidesmosome assembly and underlies Non- Herlitz junctional epidermolysis bullosa without pyloric atresia? *J Invest Dermatol* ***114***:1061-1064, 2000

108. Chavanas S et al: Splicing modulation of integrin beta4 pre-mRNA carrying a branch point mutation underlies epidermolysis bullosa with pyloric atresia undergoing spontaneous amelioration with ageing. *Hum Mol Genet* ***8***:2097-2105, 1999

109. Gache Y et al: Genetic bases of severe junctional epidermolysis bullosa presenting spontaneous amelioration with aging. *Hum Mol Genet* ***10***:2453-2461, 2001

110. Pfendner EG et al: Basic science of epidermolysis bullosa and diagnostic and molecular characterization: Proceedings of the IInd International Symposium on Epidermolysis Bullosa, Santiago, Chile, 2005. *Int J Dermatol* ***46***:781-794, 2007

111. Varki R et al: Epidermolysis bullosa. I. Molecular genetics of the junctional and hemidesmosomal variants. *J Med Genet* ***43***:641-652, 2006

112. Kivirikko S et al: Mutational hotspots in the LAMB3 gene in the lethal (Herlitz) type of junctional epidermolysis bullosa. *Hum Mol Genet* ***5***:231-237, 1996

113. McGrath JA et al: Altered laminin 5 expression due to mutations in the gene encoding the B3 chain in generalized atrophic benign epidermolysis bullosa. *J Invest Dermatol* ***104***:467-474, 1995

114. Cserhalmi-Friedman PB et al: Molecular basis of non-lethal junctional epidermolysis bullosa: Identification of a 38 basepair insertion and a splice site mutation in exon 14 of the LAMB3 gene. *Exp Dermatol* ***7***:105-111, 1998

115. Pulkkinen L et al: LAMB3 mutations in generalized atrophic benign epidermolysis bullosa: Consequences at the mRNA and protein levels. *Lab Invest* ***78***:859-867, 1998

116. Vaisanen L et al: Molecular mechanisms of junctional epidermolysis bullosa: Col 15 domain mutations decrease the thermal stability of collagen XVII. *J Invest Dermatol* ***125***:1112-1118, 2005

117. Fontao L et al: Molecular consequences of deletion of the cytoplasmic domain of bullous pemphigoid 180 in a patient with predominant features of epidermolysis bullosa simplex. *J Invest Dermatol* ***122***:65-72, 2004

118. Floeth M et al: Novel homozygous and compound heterozygous COL17A1 mutations associated with junctional epidermolysis bullosa. *J Invest Dermatol* ***111***:528-533, 1998

119. Jonkman MF et al: Revertant mosaicism in epidermolysis bullosa caused by mitotic gene conversion. *Cell* ***88***:543-551, 1997

120. Pasmooij A et al: Multiple correcting COL17A1 mutations in patients with revertant mosaicism of epidermolysis bullosa. *Am J Hum Genet* ***77***:727-40, 2005

121. Hashimoto K, Matsumoto M, Iacobelli D: Transient bullous dermolysis of the newborn. *Arch Dermatol* ***121***:1429-1438, 1985

122. Smith LT, Sybert VP: Intra-epidermal retention of type VII collagen in a patient with recessive dystrophic epidermolysis bullosa. *J Invest Dermatol* ***94***:261, 1990

123. Cui Y et al: Identification and characterization of genes that are required for the accelerated degradation of mRNAs containing a premature translational termination codon. *Genes Dev* ***9***:423-436, 1995

124. Uitto J, Pulkkinen L, Christiano AM: Molecular basis of the dystrophic and junctional forms of epidermolysis bullosa: Mutations in the type VII collagen and kalinin (laminin 5) genes. *J Invest Dermatol* ***103***:39S-46S, 1994

125. Christiano AM et al: Premature termination codons in the type VII collagen gene (COL7A1) underlie severe, mutilating recessive dystrophic epidermolysis bullosa. *Genomics* ***21***:160-168, 1994

126. Almaani N et al: Revertant mosaicism in recessive dystrophic epidermolysis bullosa. *J Invest Dermatol* ***130***:1937-1940, 2010

127. Mellerio JE et al: Allelic heterogeneity of dominant and recessive COL7A1 mutations underlying epidermolysis bullosa pruriginosa. *J Invest Dermatol* ***112***:984-987, 1999

128. Bruckner-Tuderman L et al: Immunohistochemical and mutation analyses demonstrate that procollagen VII is processed to collagen VII through removal of the NC-2 domain. *J Cell Biol* ***131***:551-559, 1995

129. Kindler T: Congenital poikiloderma with traumatic bulla formation and progressive cutaneous atrophy. *Br J Dermatol* ***66***:104-111, 1954

130. Ashton G: Kindler syndrome. *Clin Exp Dermatol* ***29***:116-121, 2004

131. Patrizi A et al: Kindler syndrome: Report of a case with ultrastructural study and review of the literature. *Pediatr Dermatol* ***13***:397-402, 1996

132. Haber R, Hanna W: Kindler syndrome. Clinical and ultrastructural findings. *Arch Dermatol* ***132***:1487-1490, 1996

133. Forman A et al: Kindler syndrome: Report of two cases and review of the literature. *Pediatr Dermatol* ***6***:91-101, 1989

134. Hovnanian A, Blanchet-Bardon C, de Prost Y: Poikiloderma of Theresa Kindler: Report of a case with ultrastructural study, and review of the literature. *Pediatr Dermatol* ***6***:82-90, 1989

135. Hacham-Zadeh S, Garfunkel A: Kindler syndrome in two related Kurdish families. *Am J Med Genet* ***20***:43-48, 1985

136. Verret J et al: [Kindler syndrome. Case report with ultrastructure study]. [Article in French.] *Ann Dermatol Venereol* ***111***:259-269, 1984

137. Lai-Cheong JE et al: Kindler syndrome: A focal adhesion genodermatosis. *Br J Dermatol* ***160***:233-242, 2009

138. Has C et al: Molecular basis of Kindler syndrome in Italy: Novel and recurrent Alu/Alu recombination, splice site, nonsense, and frameshift mutations in the KIND1 gene. *J Invest Dermatol* ***126***:1776-1783, 2006

139. Lanschuetzer C et al: Gene symbol: Kind1. Disease: Kindler syndrome. *Hum Genet* ***115***:175, 2004

140. Ashton G et al: Recurrent mutations in kindlin-1, a novel keratinocyte focal contact protein, in the autosomal recessive skin fragility and photosensitivity disorder, Kindler syndrome. *J Invest Dermatol* ***122***:78-83, 2004

141. Fassihi H et al: Prenatal diagnosis for severe inherited skin disorders: 25 years' experience. *Br J Dermatol* ***154***:106-113, 2006

142. Marinkovich MP et al: Prenatal diagnosis of Herlitz junctional epidermolysis bullosa by amniocentesis. *Prenat Diagn* ***15***:1027-1034, 1995

143. McGrath JA et al: First trimester DNA-based exclusion of recessive dystrophic epidermolysis bullosa from chorionic villus sampling. *Br J Dermatol* ***134***:734-739, 1996

144. Cserhalmi-Friedman PB et al: Preimplantation genetic diagnosis in two families at risk for recurrence of Herlitz junctional epidermolysis bullosa. *Exp Dermatol* ***9***:290-297, 2000

145. Kaiser J: Prenatal diagnosis. An earlier look at baby's genes. *Science* ***309***:1476-1478, 2005

146. Lin AN, Carter DM, eds. *Epidermolysis Bullosa: Basic and Clinical Aspects*. New York, Springer-Verlag, 1992, p. 302.

147. Terrill PJ et al: The surgical management of dystrophic epidermolysis bullosa (excluding the hand). *Br J Plast Surg* ***45***:426-434, 1992

148. Terrill PJ, Mayou BJ, Pemberton J: Experience in the surgical management of the hand in dystrophic epidermolysis bullosa. *Br J Plast Surg* ***45***:435-442, 1992

149. Ladd AL, Kibele A, Gibbons S: Surgical treatment and postoperative splinting of recessive dystrophic epidermolysis bullosa. *J Hand Surg Am* ***21***:888-897, 1996

150. Greider JL, Flatt AE: Surgical restoration of the hand in epidermolysis bullosa. *Arch Dermatol* ***124***:765-767, 1988

151. Glicenstein J, Mariani D, Haddad R: The hand in recessive dystrophic epidermolysis bullosa. *Hand Clin* ***16***:637-45, 2000

152. Falabella AF et al: Tissue-engineered skin (Apligraf) in the healing of patients with epidermolysis bullosa wounds. *Arch Dermatol* ***136***:1225-1230, 2000

153. Bastin KT, Steeves RA, Richards MJ: Radiation therapy for squamous cell carcinoma in dystrophic epidermolysis bullosa: Case reports and literature review. *Am J Clin Oncol* ***20***:55-58, 1997

154. Fine JD et al: Chemoprevention of squamous cell carcinoma in recessive dystrophic epidermolysis bullosa: Results of a phase 1 trial of systemic isotretinoin. *J Am Acad Dermatol* ***50***:563-571, 2004

155. Arnold AW et al: Cetuximab therapy of metastasizing cutaneous squamous cell carcinoma in a patient with severe recessive dystrophic epidermolysis bullosa. *Dermatology* ***219***(1):80-83, 2009

156. Ergun GA et al: Gastrointestinal manifestations of epidermolysis bullosa. A study of 101 patients. *Medicine* ***71***:121-127, 1992

157. Haynes L et al: Gastrostomy and growth in dystrophic epidermolysis bullosa. *Br J Dermatol* ***134***:872-879, 1996

158. McDonnell PJ, Schofield OMV, Spalton DJ: Eye involvement in junctional epidermolysis bullosa. *Arch Opthalmol* ***107***:1635-1637, 1989

159. Gans LA: Eye lesions of epidermolysis bullosa. *Arch Dermatol* ***124***:762-764, 1988

160. Kirkham J et al: The chemical composition of tooth enamel in junctional epidermolysis bullosa. *Arch Oral Biol* ***45***:377-386, 2000

161. Serrano Martinez C et al: Hereditary epidermolysis bullosa. Dental management of three cases. *Med Oral* ***6***:48-56, 2001

162. Travis SP et al: Oral and gastrointestinal manifestations of epidermolysis bullosa. *Lancet* ***340***:1505-1506, 1992

163. Tesi D, Lin AN: Nutritional management of the epidermolysis bullosa patient. In: *Epidermolysis Bullosa – Basic and Clinical Aspects*, edited by AN Lin, DM Carter. New York, Springer-Verlag, 1992, Chapter 21.

164. Lara-Corrales I, Pope E: Dilated cardiomyopathy in epidermolysis bullosa. *Dermatol Clin* ***28***(2):347-351, 2010

165. Fridge JL, Vichinsky EP: Correction of the anemia of epidermolysis bullosa with intravenous iron and erythropoietin. *J Pediatr*. ***132***:871-873, 1998

166. Ingen-Housz-Oro S et al: Vitamin and trace metal levels in recessive dystrophic epidermolysis bullosa. *J Eur Acad Dermatol Venereol* ***18***(6):649-653, 2004

167. Martinez AE, Mellerio JE: Osteopenia and osteoporosis in epidermolysis bullosa. *Dermatol Clin* ***28***(2):353-355, 2010

168. Dietz M: A day in the life of a patient with DDEB. *J Am Acad Dermatol* ***51***:S58-S59, 2004

169. Goldschneider KR, Lucky AW: Pain management in epidermolysis bullosa. *Dermatol Clin* ***28***:273-282, ix, 2010

170. Tabolli S et al: Quality of life in patients with epidermolysis bullosa. *Br J Dermatol* ***161***:869-877, 2009

171. Schomer H, Vergunst R: Psychological factors in epidermolysis bullosa. *S Afr Med J* ***81***:580, 1992

172. Moss K: Contact at the borderline: Psychoanalytic psychotherapy with EB patients. *Br J Nurs* ***17***:449-455, 2008

173. Lansdown R et al: Practical and psychological problems for parents of children with epidermolysis bullosa. *Child Care Health Dev* ***12***:251-256, 1986

174. Veien NK, Buus SK: Treatment of epidermolysis bullosa simplex (EBS) with tetracycline. *Arch Dermatol* ***136***:424-425, 2000

175. Rothnagel JA et al: Transgenic models of skin diseases. *Arch Dermatol* ***129***:1430-1436, 1993

176. Cao T et al: An inducible mouse model for epidermolysis bullosa simplex: Implications for gene therapy. *J Cell Biol* ***152***:651-656, 2001

177. Bruckner-Tuderman L et al: Animal models of epidermolysis bullosa: Update 2010. *J Invest Dermatol* ***130***:1485-1488, 2010

178. Bubier JA et al: A mouse model of generalized non-Herlitz junctional epidermolysis bullosa. *J Invest Dermatol* ***130***:1819-1828, 2010

179. Meng X et al: Targeted inactivation of murine laminin gamma2-chain gene recapitulates human junctional epidermolysis bullosa. *J Invest Dermatol* ***121***:720-731, 2003

180. Natsuga K et al: Animal models of epidermolysis bullosa. *Dermatol Clin* ***28***:137-142, 2010

181. Heinonen S et al: Targeted inactivation of the type VII collagen gene (Col7a1) in mice results in severe blistering phenotype: A model for recessive dystrophic epidermolysis bullosa. *J Cell Sci* ***112***:3641-3648, 1999

182. Kim YH et al: Recessive dystrophic epidermolysis bullosa phenotype is preserved in xenografts using SCID mice: Development of an experimental in vivo model. *J Invest Dermatol* ***98***:191-197, 1992

183. Woodley DT et al: Injection of recombinant human type VII collagen restores collagen function in dystrophic epidermolysis bullosa. *Nat Med* ***10***:693-695, 2004

184. Ferrari S et al: Gene therapy approaches for epidermolysis bullosa. *Clin Dermatol* ***23***:430-436, 2005

185. Titeux M, Pendaries V, Hovnanian A: Gene therapy for recessive dystrophic epidermolysis bullosa. *Dermatol Clin* ***28***:361-366, xii, 2010

186. Seitz CS et al: BP180 gene delivery in junctional epidermolysis bullosa. *Gene Ther* ***6***:42-47, 1999

187. Robbins PB et al: In vivo restoration of laminin 5 beta 3 expression and function in junctional epidermolysis bullosa. *Proc Natl Acad Sci USA* ***98***:5193-5198, 2001

188. Ortiz-Urda S et al: Stable nonviral genetic correction of inherited human skin disease. *Nat Med* ***8***:1166-1170, 2002

189. Ortiz-Urda S et al: Injection of genetically engineered fibroblasts corrects regenerated human epidermolysis bullosa skin tissue. *J Clin Invest* ***111***:251-255, 2003

190. Woodley DT et al: Intradermal injection of lentiviral vectors corrects regenerated human dystrophic epidermolysis bullosa skin tissue in vivo. *Mol Ther* ***10***:318-326, 2004

191. Baldeschi C et al: Genetic correction of canine dystrophic epidermolysis bullosa mediated by retroviral vectors. *Hum Mol Genet* ***12***:1897-1905, 2003

192. Mavilio F et al: Correction of junctional epidermolysis bullosa by transplantation of genetically modified epidermal stem cells. *Nat Med* ***12***:1397-402, 2006

193. Marinkovich MP et al: Cellular origin of the dermal-epidermal basement membrane. *Dev Dyn* ***197***:255-267, 1993

194. Woodley DT et al: Normal and gene-corrected dystrophic epidermolysis bullosa fibroblasts alone can produce type VII collagen at the basement membrane zone. *J Invest Dermatol* ***121***:1021-1028, 2003

195. Remington J et al: Injection of recombinant human type VII collagen corrects the disease phenotype in a murine model of dystrophic epidermolysis bullosa. *Mol Ther* ***17***:26-33, 2009

196. Wong T et al: Potential of fibroblast cell therapy for recessive dystrophic epidermolysis bullosa. *J Invest Dermatol* ***128***:2179-2189, 2008

197. Yan WF, Murrell DF: Fibroblast-based cell therapy strategy for recessive dystrophic epidermolysis bullosa. *Dermatol Clin **28***:367-370, xii, 2010

198. Kiuru, M et al: Bone marrow stem cell therapy for recessive dystrophic epidermolysis bullosa. *Dermatol Clin* 28:371-382, xii-xiii, 2010

199. Tolar J et al: Amelioration of epidermolysis bullosa by transfer of wild-type bone marrow cells. *Blood **113***:1167-1174, 2009

200. Tamai K, Kaneda Y, Uitto J: Molecular therapies for heritable blistering diseases. *Trends Mol Med **15***:285-292, 2009

201. Wagner JE et al: Bone marrow transplantation for recessive dystrophic epidermolysis bullosa. *N Engl J Med **363***(7):629-639, 2010