GEPHE SUMMARY

Gephebase Gene
ameloblastin (AMBN) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^ameloblastin (AMBN)^#gephebase-summary-title)

GepheID
GP00001938

Entry Status
Published

Main curator
Courtier

PHENOTYPIC CHANGE

Trait Category
Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait
Tooth absence (no enamel production) (https://www.gephebase.org/search-criteria?/and+Trait=^Tooth absence (no enamel production)^#gephebase-summary-title)

Trait State in Taxon A
presence of teeth

Trait State in Taxon B
absence of teeth

Ancestral State
Taxon A

Taxonomic Status
Intergeneric or Higher (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intergeneric or Higher^#gephebase-summary-title)

Taxon A

Latin Name
Cetacea (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Cetacea^#gephebase-summary-title)

Common Name
whales

Synonyms
whales; cetaceans; whale; whales, dolphins, and porpoises

Rank
order

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla

Parent
Cetartiodactyla (whales, hippos, ruminants, pigs, camels etc.) - (Rank: no rank) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 91561)

NCBI Taxonomy ID
9721 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9721)

is Taxon A an Infraspecies?
No

Taxon B

Latin Name
Mysticeti (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Mysticeti^#gephebase-summary-title)

Common Name
baleen whales

Synonyms
baleen whales

Rank
suborder

Lineage
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Cetartiodactyla; Cetacea

Parent
Cetacea (whales) - (Rank: order) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9721)

NCBI Taxonomy ID
9761 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9761)

is Taxon B an Infraspecies?
No

GENOTYPIC CHANGE

Generic Gene Name
AMBN

Synonyms
AI1F

String
9606.ENSP00000313809 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier=9606.ENSP00000313809)

Sequence Similarities
Belongs to the ameloblastin family.

GO - Molecular Function
GO:0008083 : growth factor activity (https://www.ebi.ac.uk/QuickGO/term/GO:0008083)
GO:0030345 : structural constituent of tooth enamel (https://www.ebi.ac.uk/QuickGO/term/GO:0030345)

GO - Biological Process
GO:0007155 : cell adhesion (https://www.ebi.ac.uk/QuickGO/term/GO:0007155)
GO:0044267 : cellular protein metabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0044267)

UniProtKB Homo sapiens
Q9NP70 (http://www.uniprot.org/uniprot/Q9NP70)

GenebankID or UniProtKB
()

GO:0043687 : post-translational protein modification (https://www.ebi.ac.uk/QuickGO/term/GO:0043687)
GO:0042475 : odontogenesis of dentin-containing tooth (https://www.ebi.ac.uk/QuickGO/term/GO:0042475)
GO:0042127 : regulation of cell proliferation (https://www.ebi.ac.uk/QuickGO/term/GO:0042127)
GO:0031214 : biomineral tissue development (https://www.ebi.ac.uk/QuickGO/term/GO:0031214)

GO - Cellular Component

GO:0005576 : extracellular region (https://www.ebi.ac.uk/QuickGO/term/GO:0005576)
GO:0005788 : endoplasmic reticulum lumen (https://www.ebi.ac.uk/QuickGO/term/GO:0005788)

Presumptive Null

Yes (https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title)

Molecular Type

Coding (https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title)

Aberration Type

Unknown (https://www.gephebase.org/search-criteria?/and+Aberration Type=^Unknown^#gephebase-summary-title)

Molecular Details of the Mutation

multiple frameshift mutations

Experimental Evidence

Candidate Gene (https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title)

Main Reference

Morphological and molecular evidence for a stepwise evolutionary transition from teeth to baleen in mysticete whales. (2008) (https://pubmed.ncbi.nlm.nih.gov/18266181)

Authors

DemÃ©rÃ© TA; McGowen MR; Berta A; Gatesy J

Abstract

The origin of baleen in mysticete whales represents a major transition in the phylogenetic history of Cetacea. This key specialization, a keratinous sieve that enables filter-feeding, permitted exploitation of a new ecological niche and heralded the evolution of modern baleen-bearing whales, the largest animals on Earth. To date, all formally described mysticete fossils conform to two types: toothed species from Oligocene-age rocks (approximately 24 to 34 million years old) and toothless species that presumably utilized baleen to feed (Recent to approximately 30 million years old). Here, we show that several Oligocene toothed mysticetes have nutrient foramina and associated sulci on the lateral portions of their palates, homologous structures in extant mysticetes house vessels that nourish baleen. The simultaneous occurrence of teeth and nutrient foramina implies that both teeth and baleen were present in these early mysticetes. Phylogenetic analyses of a supermatrix that includes extinct taxa and new data for 11 nuclear genes consistently resolve relationships at the base of Mysticeti. The combined data set of 27,340 characters supports a stepwise transition from a toothed ancestor, to a mosaic intermediate with both teeth and baleen, to modern baleen whales that lack an adult dentition but retain developmental and genetic evidence of their ancestral toothed heritage. Comparative sequence data for ENAM (enamelin) and AMBN (ameloblastin) indicate that enamel-specific loci are present in Mysticeti but have degraded to pseudogenes in this group. The dramatic transformation in mysticete feeding anatomy documents an apparently rare, stepwise mode of evolution in which a composite phenotype bridged the gap between primitive and derived morphologies; a combination of fossil and molecular evidence provides a multifaceted record of this macroevolutionary pattern.

Additional References

Pseudogenization of the tooth gene enamelysin (MMP20) in the common ancestor of extant baleen whales. (2011) (https://pubmed.ncbi.nlm.nih.gov/20861053)

RELATED GEPHE

Related Genes

3 (amelogenin (AMEL), enamelin (ENAM), enamelysin (MMP20)) (https://www.gephebase.org/search-criteria?/or+Taxon ID=^9721^/and+Trait=Tooth absence/or+Taxon ID=^9761^/and+Trait=Tooth absence/and+groupHaplotypes=true#gephebase-summary-title)

Related Haplotypes

No matches found.

EXTERNAL LINKS

COMMENTS

Cladistic analyses suggest that functional teeth were lost in the common ancestor of crown-group Mysticeti. The amelogenin (AMEL) gene contains various gene null mutations in various species. it is possible that frameshift mutations and/or stop codons will be discovered in the unsequenced protein-coding regions of one or more of these extracellular matrix protein (EMP) genes. A second possibility is that one or more of these genes were initially silenced by mutations in a regulatory gene region on the ancestral mysticete branch, and that mutations in protein-coding regions accumulated subsequently on descendant branches within crown-group Mysticeti. A third possibility is that a different enamel- or tooth-specific gene was knocked out in the common ancestor of mysticetes and that AMBN ENAM and AMEL acquired molecular cavities on descendant branches within crown-group Mysticeti. Alternatively enamel may have been lost independently in several mysticete lineages rather than once in the common ancestor of crown mysticetes.