Identification and Phylogenetic Analysis of *Drosophila melanogaster* Myosins

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Myosins constitute a superfamily of motor proteins that convert energy from ATP hydrolysis into mechanical movement along actin filaments. All known myosins comprise an N terminal head domain, which includes ATP and actin binding motifs, a neck regulatory domain, that is a site of light chains binding, and a highly divergent tail domain. Phylogenetic analysis currently places myosins into 17 classes based on class specific features of their conserved 80 kDa motor domain. Traditionally the myosins have been divided into two classes depending on whether they form monomers or dimers. The conventional myosin of muscle and non-muscle cells forms class II myosins. They are complex molecules of four light chains bound to two heavy chains that form bipolar filaments via interactions between their coiled-coil tails (type II). Class I myosins are smaller monomeric myosins referred to as unconventional myosins. Now there are at least 15 other classes of unconventional myosins.

Current research concentrates on the functional analysis of these new types of myosins. A number of studies suggests that these motors play important roles in a variety of cellular functions including organelle, RNA and/or protein transport, maintenance of the cell architecture, cell movements, and signal transduction.

How many myosins are needed to ensure the proper development and function of eukariotic organisms? Thus far, three types of myosins were found in budding yeast, six in the nematode *C. elegans*, and at least nine in human.

My current research is concentrated on the identification and classification of *Drosophila melanogaster* myosins. The completed *Drosophila melanogaster* Genome Project was used to determine the number of myosins encoding genes in this species and to classify them. This classification is based on the sequence comparison of the myosin core motor domains, equivalent to amino acids 88 to 780 of chicken skeletal myosin II. The motor domain is highly conserved among all myosins, reflecting the high conservation of its function. However, it has a number of class specific features (characteristic inserts or substitutions) which might be equally important in defining the function of a given myosin. Phylogenetic analysis of the tail domain sequences produces similar results indicating that heads and tails have coevolved.

Phylogenetic analysis of the 12 identified myosin genes suggests they can be divided into nine major classes. In *Drosophila* eight different myosin genes were described thus far.

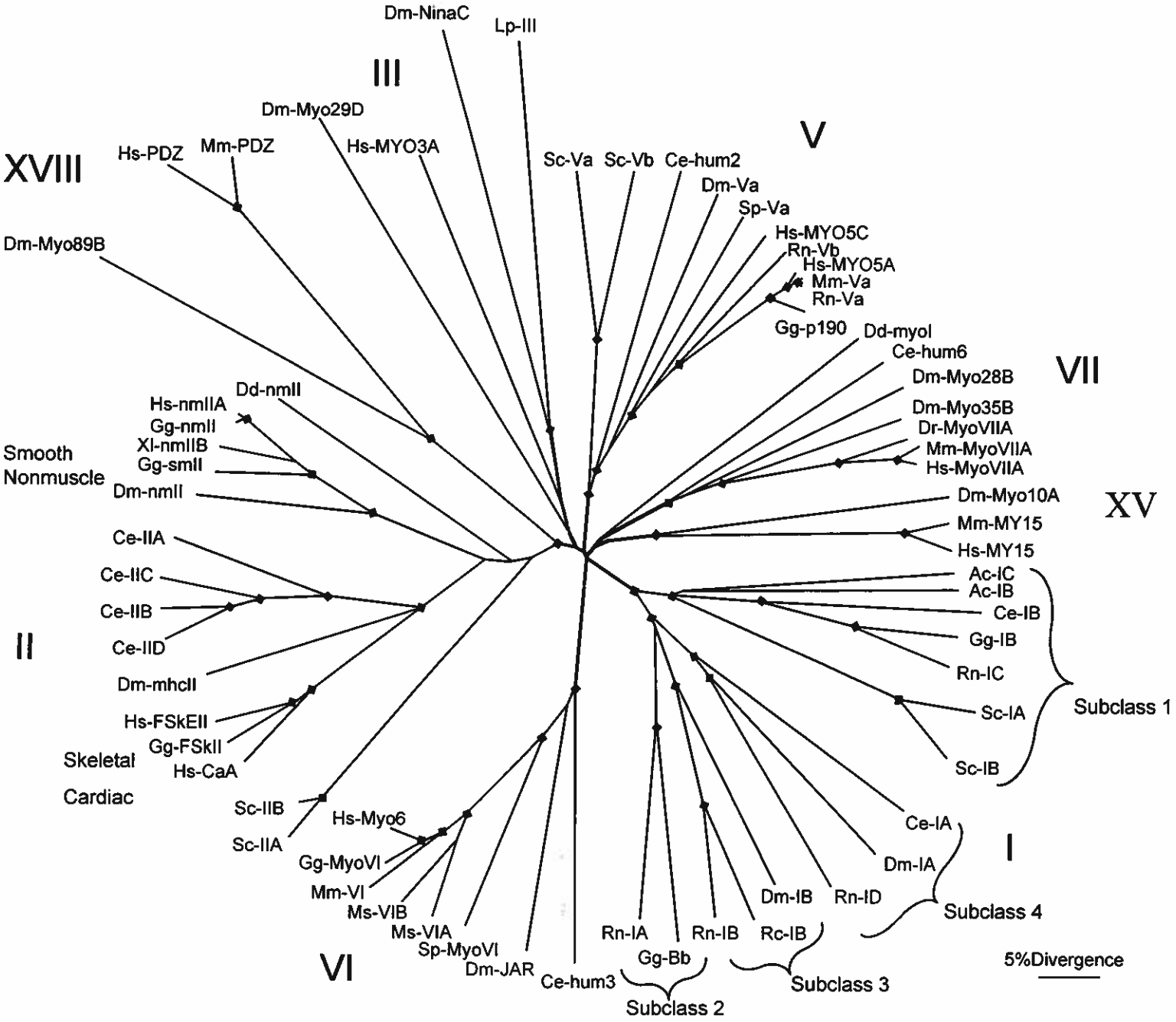
Dm-NinaC
Lp-III
III
Dm-Myo29D
Hs-PDZ
Mm-PDZ
Hs-MYO3A
XVIII
V
Sc-Va
Sc-Vb
Ce-hum2
Dm-Va
Sp-Va
Hs-MYO5C
Rn-Vb
Hs-MYO5A
Mm-Va
Rn-Va
Dm-Myo89B
Gg-p190
Dd-myoI
Ce-hum6
VII
Dm-Myo28B
Dd-nmII
Hs-nmIIA
Dm-Myo35B
Gg-nmII
Dr-MyoVIIA
Xl-nmIIB
Mm-MyoVIIA
Smooth
Nonmuscle
Gg-smII
Hs-MyoVIIA
Dm-nmII
Dm-Myo10A
XV
Mm-MY15
Ce-IIA
Hs-MY15
Ce-IIC
Ac-IC
Ce-IIB
Ac-IB
Ce-IB
II
Ce-IID
Gg-IB
Rn-IC
Dm-mhcII
Sc-IA
Subclass 1
Hs-FSkEII
Sc-IB
Gg-FSkII
Skeletal
Hs-CaA
Ce-IA
Cardiac
Sc-IIB
Hs-Myo6
I
Dm-IA
Sc-IIA
Gg-MyoVI
Dm-IB
Rn-ID
Mm-VI
Subclass 4
Ms-VIB
Rn-IA
Rn-IB
Rc-IB
Ms-VIA
Sp-MyoVI
Gg-Bb
5%Divergence
VI
Dm-JAR
Ce-hum3
Subclass 3
Subclass 2

Table 1

Domain structure and function of the myosin classes

Class	IQ motifs	No. of heavy chains	Other domains	Function
I subclass1	One or two IQ	1 (monomer)	TH1, GPA or GPQ and SH3	Vesicle transport. Phagocytosis and cell motility
subclass2	Three to six IQ	1 (monomer)	TH1 domain	Microvilli function in the brush border
subclass3	Three IQ	1 (monomer)	TH1 domain	Epithelial development and stereocilia function
subclass4	Two IQ	1 (monomer)	TH1 domain	Epithelial development
II muscle	Two IQ	2 (dimer)		Smooth or skeletal muscle contraction
nonmuscle	Two IQ	2 (dimer)		Maintainance of the cell architecture, phagocytosis and cytokinesis
III	One or two IQ	1 (monomer)	N-terminal kinase	Role in prototransduction
IV	One IQ	1 (monomer)	MyTH4 and SH3	?
V	Six IQ	2 (dimer)	Transmembrane, specific C-terminal globular domain	Membrane trafficking, polarised cell growth. Vesicle, protein and/or mRNA transport
VI	One IQ	2 (dimer) ?	Reverse gear, specific C-terminal globular domain	Vesicle transport, epithelial morphogenesis, and stereocilia function
VII	Four or five IQ	2 (dimer) ?	MyTH4, Talin like, and SH3	Membrane trafficking, stereocilia and photoreceptor cells function
VIII	Three or four IQ	2 (dimer) ?	Serine rich domain, specific C-terminal domain	Cell wall function in plants, intracellular transport
IX	Four to six IQ	1 (monomer)	N-terminal extension, Zinc binding and GAP domains	Signalling
X	Three IQ	2 (dimer) ?	PH, MyTH4, Talin like	A role in regions of dynamic actin
XI	Five to six IQ	2 (dimer) ?		Organelle transport in plants
XII	IQ ?	2 (dimer) ?	N-terminal extension and MyTH4 domains	?
XIII	Four to seven IQ	1 (monomer)		? (In plants only)
XIV	IQ ?	1 (monomer)		? (In Toxoplasma and Plasmodium species)
XV	Two IQ	1 (monomer)	N-terminal extension MyTH4, Talin like, and SH3	Hair cell function
XVI	Two IQ	1 (monomer)	Ankyrin repeats	Neuronal cell migration
XVII	IQ ?	1 (monomer)	Chitin synthase domain	? (In Pyricularia and Emiricella species)
XVIII	One or two IQ	2 (dimer) ?	KE, and PDZ domain	? Maintainance of the stromal cell architecture