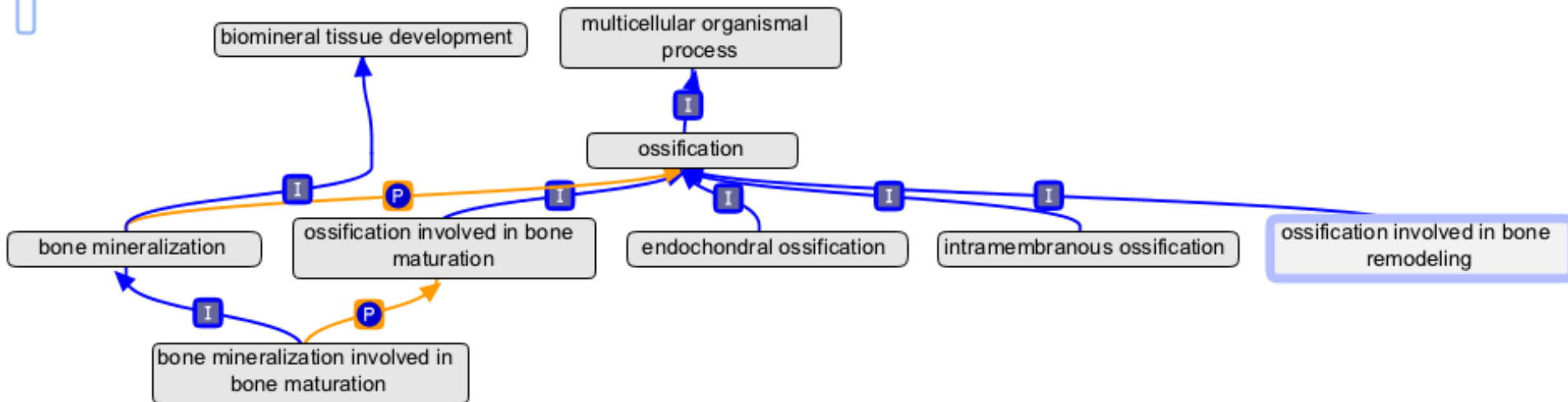


# **Gene Ontology enhancements in support of skeletal representation**

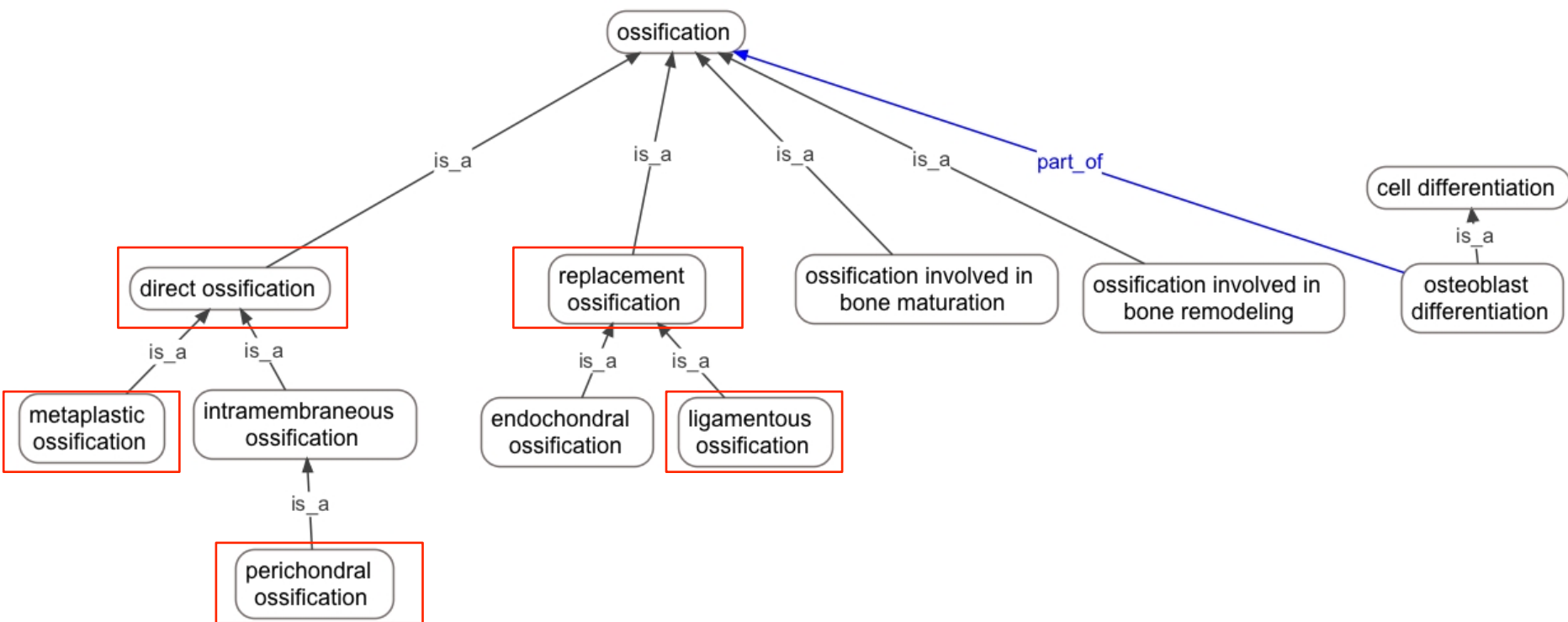
Melissa, Alex, Wasila  
November, 2011

# Currently in GO



- No notion of direct versus replacement ossification
- No siblings to endochondral, intramembranous ossification
- Some definitions need updating to be more biologically correct

# Some proposed enhancements



# **GO:0001503 ossification**

**(A multi-cellular organism process)**

**The formation of bone or of a bony substance, or the conversion of fibrous tissue or of cartilage into bone or a bony substance.**

- This seems ok.

**GO:ossification**

**The formation of bone or of a bony substance, or the conversion of fibrous tissue or of cartilage into bone or a bony substance.**

**GO:new direct ossification**

**Ossification that does not require the replacement of pre-existing tissues, most often a cartilaginous model.**

**GO:new replacement ossification**

[exact synonym: Indirect ossification]

**Ossification that requires the replacement of a pre-existing tissue prior to bone tissue formation.**

**GO:new replacement ossification**

[exact synonym: Indirect ossification]

**Ossification that requires the replacement of a pre-existing tissue prior to bone tissue formation.**

**GO:new ligamentous ossification**

**Replacement ossification wherein bone tissue replaces ligamentous tissue.**

**GO:0001958 endochondral ossification**

**The formation of bone by the replacement of cartilage tissue with mineralized bone.**

**GO:new replacement ossification**

[exact synonym: Indirect ossification]

**Ossification that requires the replacement of a pre-existing tissue prior to bone tissue formation.**

**GO:new ligamentous ossification**

**Replacement ossification wherein bone tissue replaces ligamentous tissue.**

**GO:0001958 endochondral ossification**

**Replacement ossification wherein bone tissue replaces cartilage.**

- **This is more correct because the bone does not need to be mineralized in order to classify as endochondral ossification**

**GO:new direct ossification**

Ossification that does not require the replacement of pre-existing tissues, most often a cartilaginous model.

**GO:0001957 intramembranous ossification**

The formation of bone in which osteoblasts secrete a collagen-proteoglycan matrix that binds calcium salts and becomes calcified. Intramembranous ossification is the way flat bones and the shell of a turtle are formed.

**GO:new metaplastic ossification**

Direct ossification in which bone formation occurs as result of the direct transformation of non-bone cells into bone cells without cell division



**GO:new direct ossification**  
Ossification that does not require the replacement of pre-existing tissues, most often a cartilaginous model.

**GO:0001957 intramembranous ossification**

[narrow synonym: dermal ossification]

**Direct ossification that occurs within mesenchyme or an accumulation of relatively unspecialized cells.**

- Old definition wasn't very precise.
- New definition takes into account parentage and references the mesenchyme that is a key component of the development

COMMENT TO GO: an instance of intramembranous ossification may also be classified as metaplastic. The former classifies based on tissue type location, and the latter based on mechanism/cell division.

**GO:0001957 intramembranous ossification**

[narrow synonym: dermal ossification]

**Direct ossification that occurs within mesenchyme or an accumulation of relatively unspecialized cells.**

**GO:new perichondral ossification**

**Intramembranous ossification from the surface of a cartilage element as the perichondrium becomes a periosteum, without replacement of cartilage.**

- This class is defined as a intramembranous ossification that occurs in a particular location

**GO:new direct ossification**  
**Ossification that does not require the replacement of pre-existing tissues, most often a cartilaginous model.**

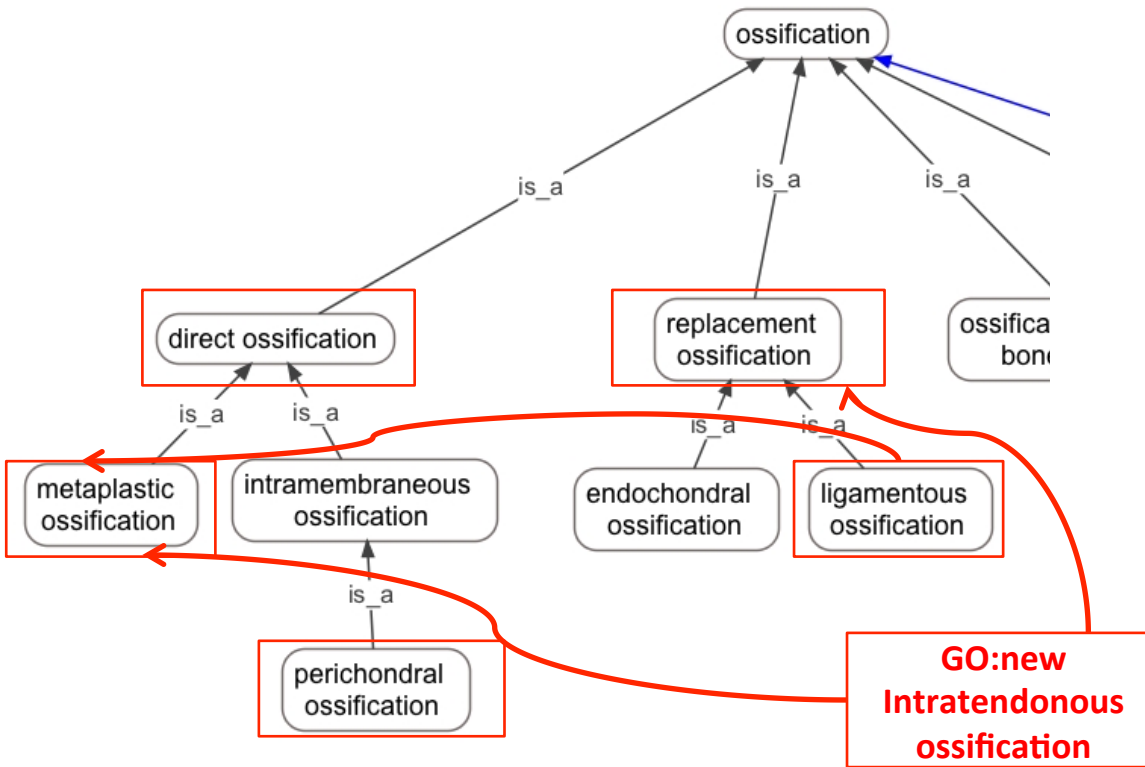
- **This class is defined as a direct ossification that occurs via a particular mechanism**

COMMENT TO GO: an instance of intramembranous ossification may also be classified as metaplastic. The former classifies based on tissue type location, and the latter based on mechanism/cell division.

**GO:new metaplastic ossification**

**Direct ossification in which bone formation occurs as result of the direct transformation of non-bone cells into bone cells without cell division**

# Some things are hard to classify



**GO:new  
intratendinous  
ossification**

**Ossification that does not require the replacement of pre-existing tissues, most often a cartilaginous model.**

**VAO:0000134 intratendinous ossification**

(is\_a ossicle)

EXACT synonym: "Ossified tendon"

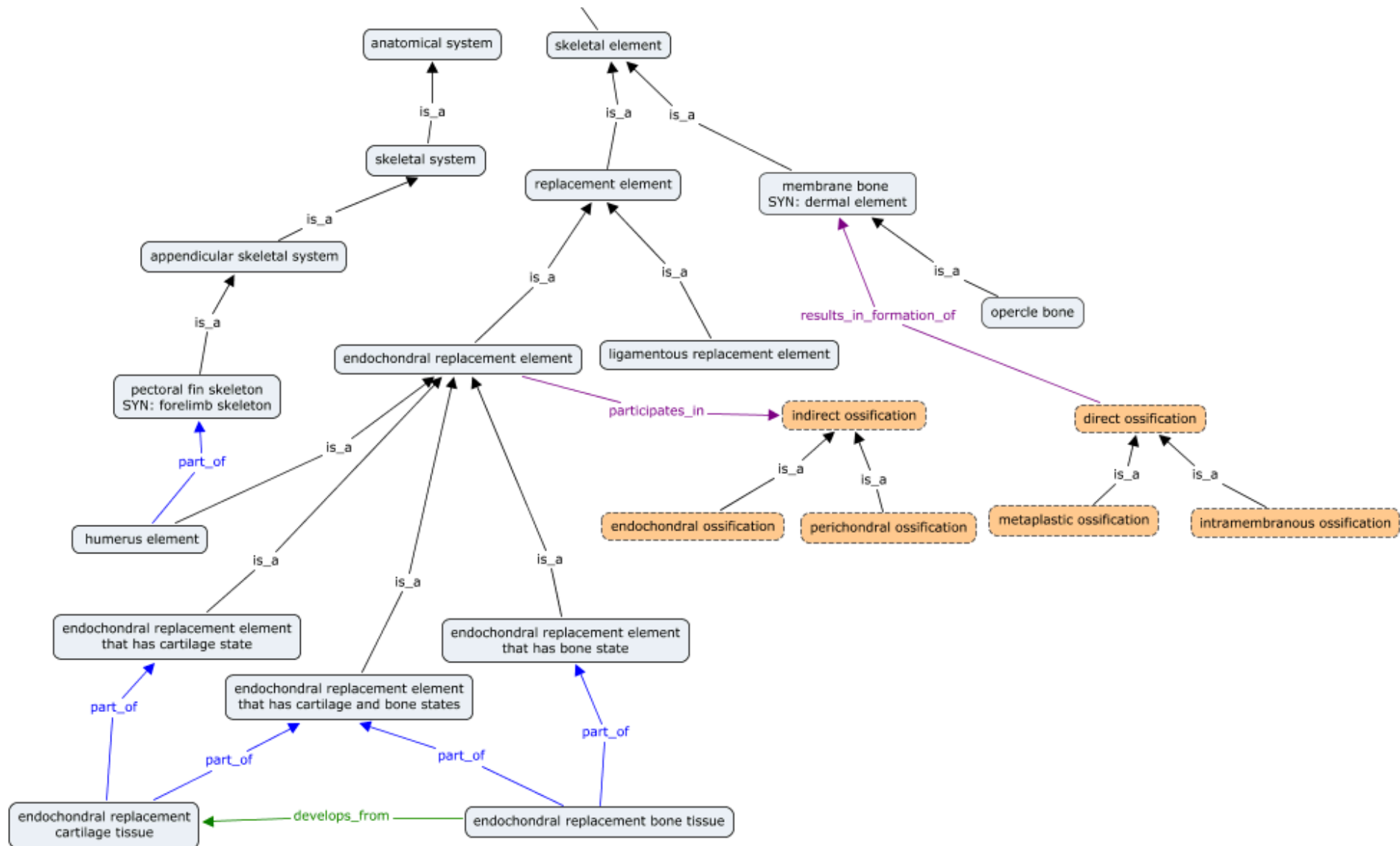
- Should be relabeled 'ossified tendon' so as not to confuse with the process

*\*note not yet defined*

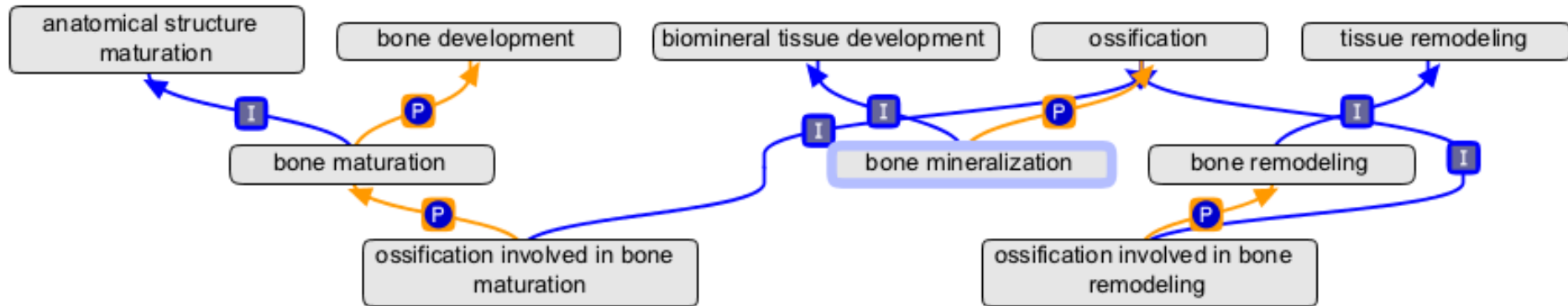
*results\_in\_formation\_of\**

- As noted earlier, probably some instances of intratendinous ossification can be classified as both metaplastic and replacement ossification. Same with ligamentous.

# Relations between GO and VAO



# Other relevant classes currently in GO



## GO:0043931 ossification involved in bone maturation

The formation of bone or of a bony substance, or the conversion of fibrous tissue or of cartilage into bone, involved in the progression of the skeleton from its formation to its mature state.

## GO:0043932 ossification involved in bone remodeling

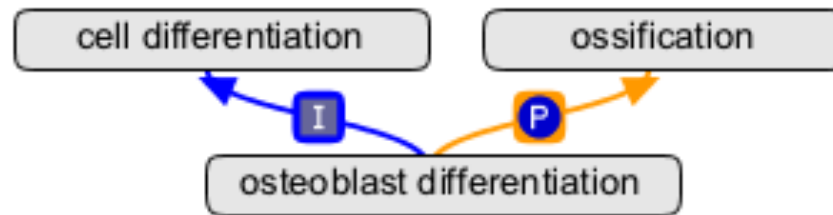
The formation of bone involved in the turnover of bone matrix and mineral in response to injury. NOTE: the label remodeling is often used in the context of amphibian development.

## GO:new ossification involved in bone modeling

The formation of bone involved in the turnover of bone matrix and mineral as part of normal development.?? Is this the same or different from our

## GO:0001649 osteoblast differentiation

The process whereby a relatively unspecialized cell acquires the specialized features of an osteoblast, a mesodermal or **neural crest cell** that gives rise to bone.



**Can we have osteoblast differentiation that is not part of some ossification process?**

(from Brian Hall) "Probably yes if you think of chondroid bone in which cells that are defined as chondroblasts transform into osteoblasts to make this intermediate tissue." Did you mean that there is some osteoblast formation that is not part of some ossification? that this intermediate tissue does not need give rise to bone tissue? We had some conflicting answers on this one, so want to be clear. BY "SOME OSSIFICATION PROCESS" I ASSUMED YOU MEANT INTRAMEMBR OR ENDOCHONDRAL OSSIFICATION (DIRECT OR INDIRECT) AS TWO PROCESSES. IF YOU CONSIDER MAKING CHONDROID BONE AN OSSIFICATION PROCESS THEN MY EXCEPTION DOES NOT APPLY. IF YOU THINK OF IT AS MAKING A TISSUE THAT IS NOT BONE THEN MY COMMENT DOES APPLY.