

# Biological Model Creation as Ontological Auditing for the Foundational Model of Anatomy

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## Overview

- Content auditing of the head and neck lymphatics of the Foundational Model of Anatomy (FMA)
- Auditing in the context of biological model construction
- Error classes:
  - (1) Computationally detectable with inferable fixes
  - (2) Computationally detectable with uninferable fixes
  - (3) Computationally undetectable
- Six subclasses of errors were algorithmically detected and one class was detected by an anatomist

## Lymphatic Drainage of the Head & Neck

The drainage of an organ part can be retrieved from the FMA and used to construct a model of metastasis for head and neck cancers. Ideally, we would query a part and retrieve its drainage pathway:

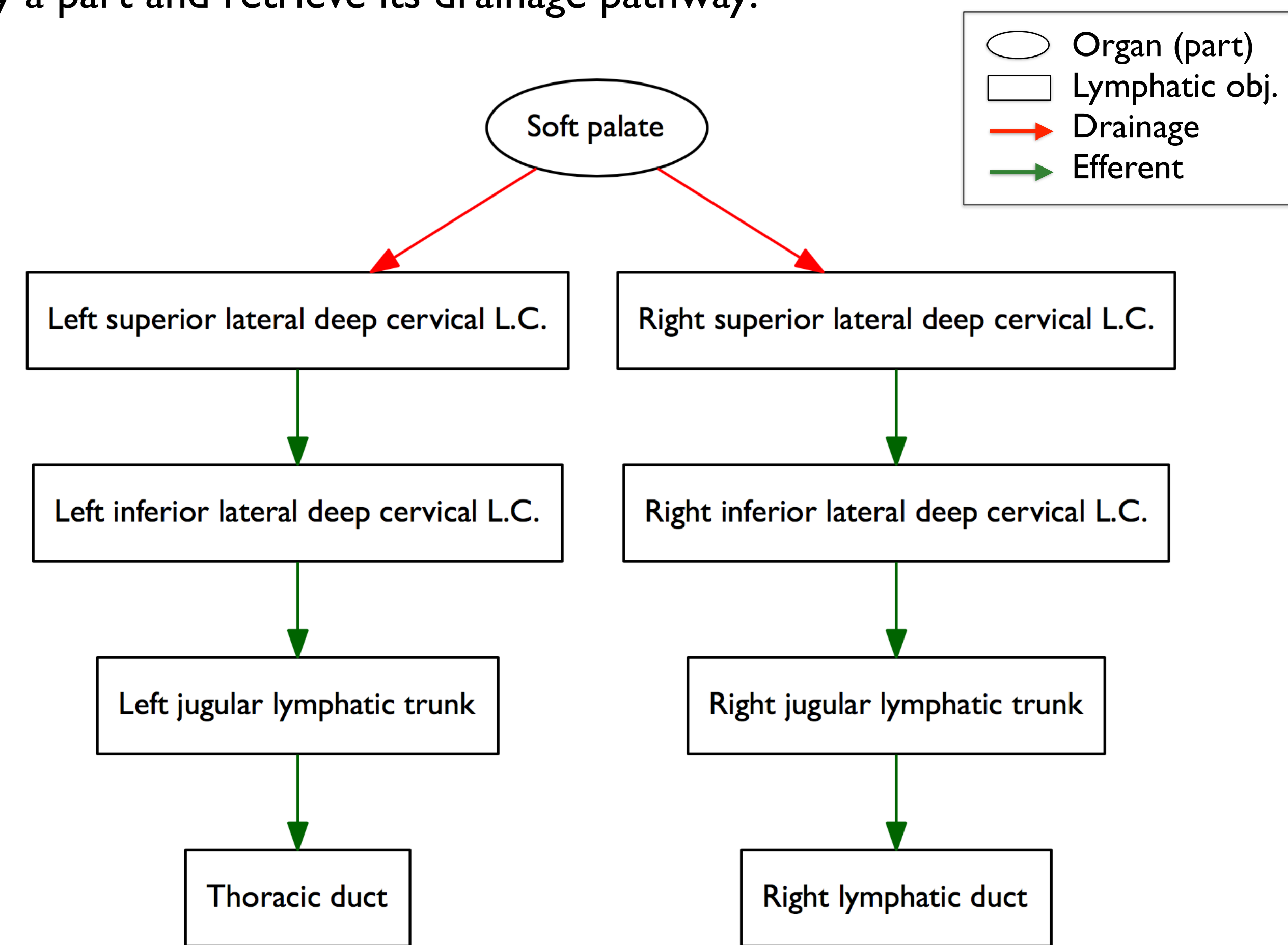


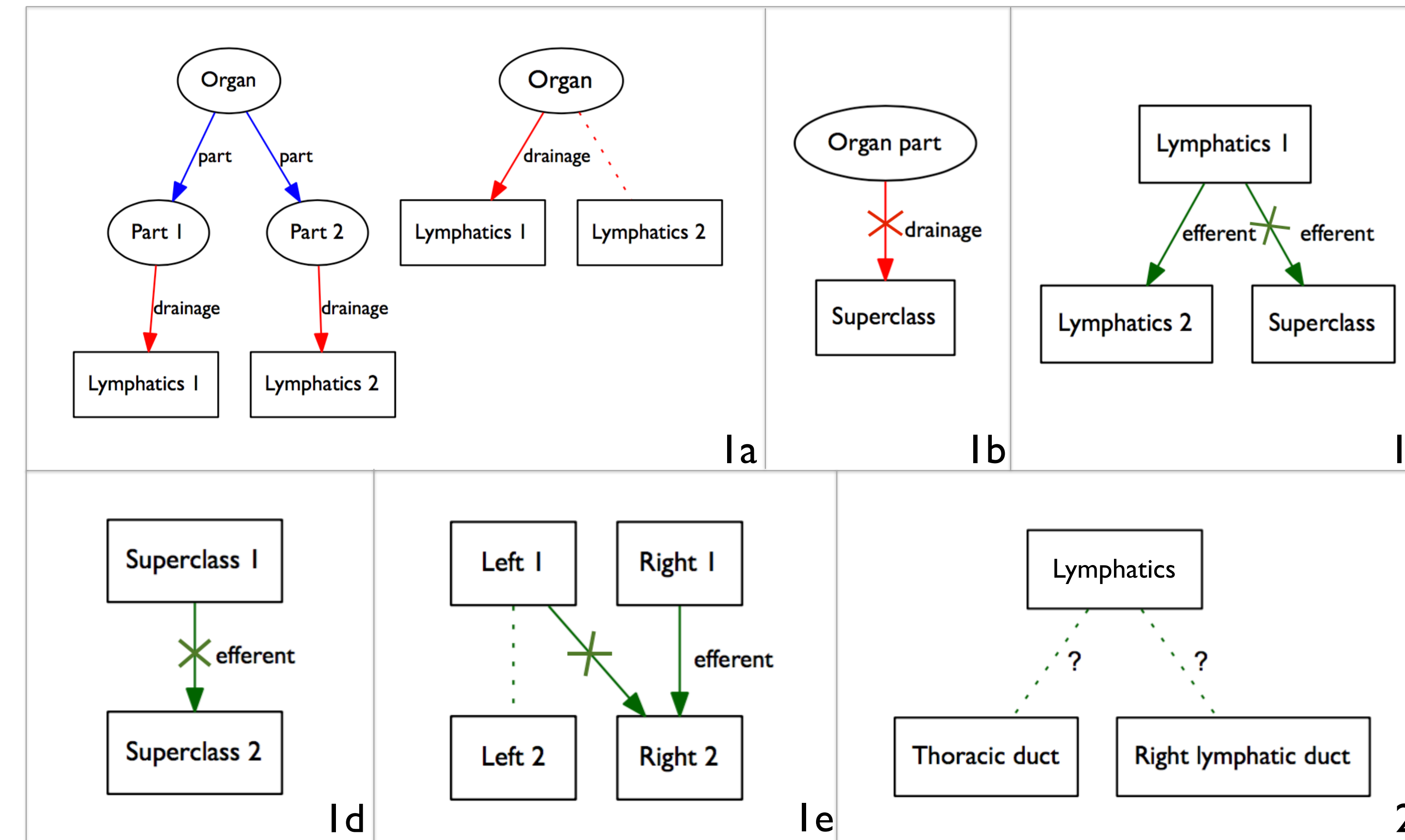
Figure: Lymphatic drainage path of the soft palate constructed from the FMA.

### FMA relationships:

*lymphatic\_drainage* — lymphatic chain which drains an organ

*efferent\_to* — downstream lymphatics

## Detectable Error Subclasses



**Class 1a** — An organ must be drained by all lymphatics that drain the organ's parts (transitivity)

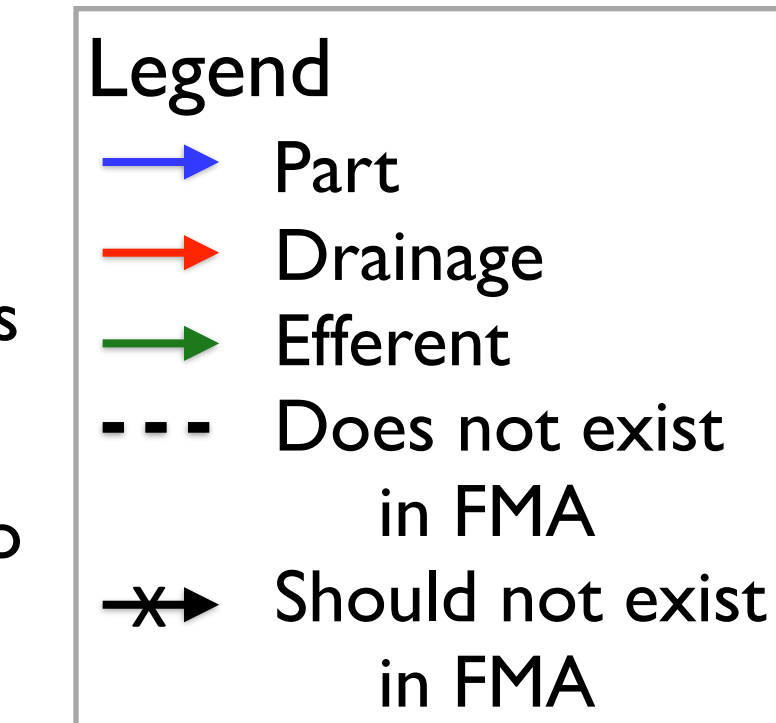
**Class 1b** — No organ or organ part should be drained by superclass lymphatics

**Class 1c** — No lymphatic object should have efferent connections to superclass lymphatics

**Class 1d** — Superclass lymphatics should not have efferent relationships to other objects

**Class 1e** — Right side lymphatics should connect to other right side lymphatics; left side to other left side lymphatics

**Class 2a** — All lymphatics must have drainage paths to one of the two lymphatic ducts



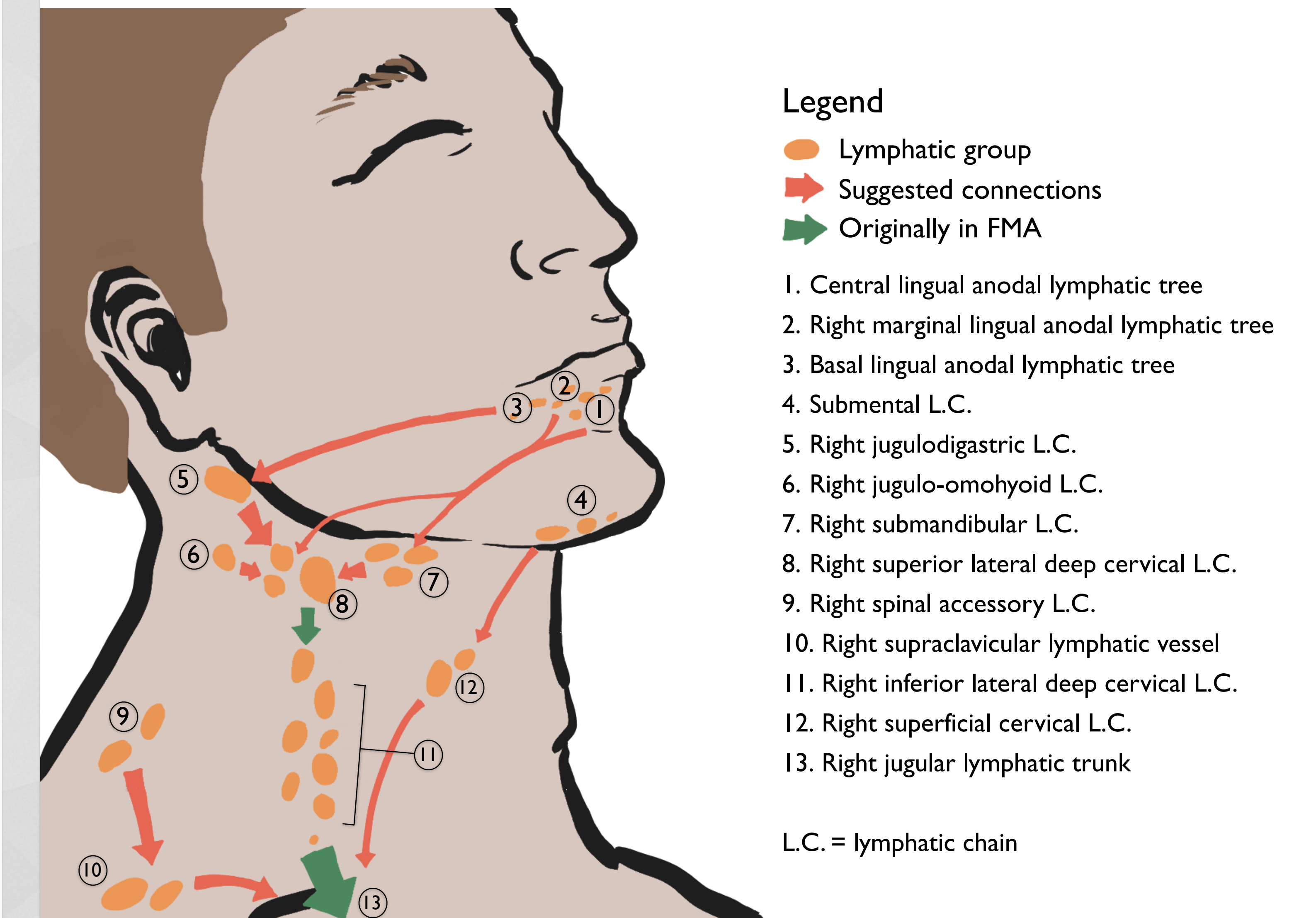
## Results

Number of objects affected and concepts suggested for addition/removal.

Error	Affects	Objects affected	Total objects	Added	Removed
1a	organ (parts)	6	106	24	-
1b	organ (parts)	4	106	6	4
1c	lymphatics	3	27	6	6
1d	superclasses	7	11	8	9
1e	lymphatics	0	27	0	0
2a	lymphatics	12	27	10*	-
3	lymphatics	7*	27	8*	4*
<b>All</b>	<b>all objects</b>	<b>37</b>	<b>144</b>	<b>62</b>	<b>23</b>

\*not computationally detected; suggested by an anatomist

## Corrected Lymphatic Drainage

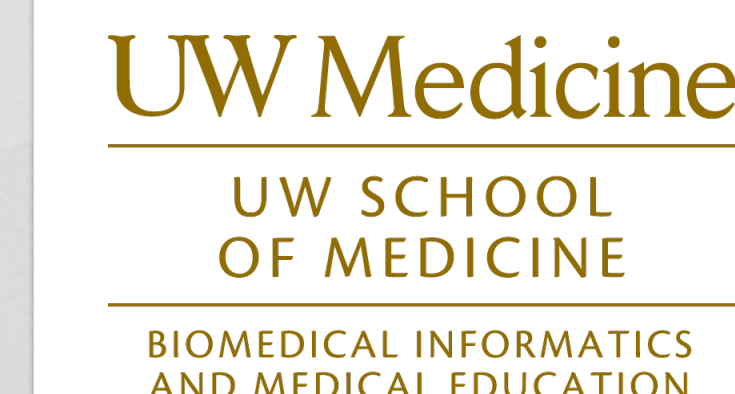


## Conclusions & Future Work

- Many inconsistencies in the FMA can be detected and fixed automatically
- Use these techniques to audit other parts of the FMA (i.e. lymphatic, circulatory, pulmonary, nervous systems)
- Corrections can then be used in future educational and research applications of the FMA

## References & Acknowledgments

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3. Kalet IJ, Mejino JL, Wang V, Whipple M, Brinkley JF. Content-specific auditing of a large scale anatomy ontology. J Biomed Inform. 2009 Jun;42(3): 540-549.



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