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Developing Graphic Libraries to Accompany the Craniofacial Human Ontology

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***Abstract*—I describe the development of two graphic libraries to accompany parts of the Craniofacial Human Ontology. One library depicts phenotypes of cleft lip. The other represents development of the human head between 4 and 8 weeks of gestation.**

***Keywords*—ontology; anatomy; visual representation; graphics**

I. Introduction

Throughout human history knowledge has been represented using many different types of symbols. Some have a natural resemblance to the signified entity (for example, illustrations and photographs), while others have an arbitrary relationship with the signified (such as the letters and numbers of writing systems). Because arbitrary symbols can more easily be translated into the raw material for computation, modern efforts to build systems to capture, store, and access biomedical knowledge rely almost exclusively on arbitrary symbols.

But for some domains of knowledge, arbitrary symbols fail to clearly communicate meaning. Instead, human understanding is best supported by symbols with natural resemblance. For these domains, representations of knowledge need to dual-encode information, using both computer-parsable symbols and human-friendly visual representation. In order for these visual representations to be useful, they should be extendable, standardized, and accessible to developers.

Anatomy is a domain that benefits from visual representation. To explore how visual representations can address shortcomings in text-based representations, I am developing two graphic libraries to accompany the Craniofacial Human Ontology (CHO) component of the Ontology of Craniofacial Development and Malformation (OCDM) [1]: one for phenotypes of cleft lip, the other for development of the human head. Both libraries are designed to communicate the form of anatomical structures, and they serve as a visual definition of classes.

II. Methods

Publicly-available images were gathered from the web and textbooks for use as references. The libraries were developed in Adobe Illustrator as line-based representations and exported as scalable vector graphics (SVGs).

This work is an extension of research I performed on the OCDM as a research assistant at the University of Washington, funded by the National Institute of Dental and Craniofacial Research under grant 1U01DE020050-01.

III. Results

The cleft lip library was constructed using a modular approach, with each graphic constructed from a common set of lines. Figure 1 demonstrates the development of graphics for right unilateral cleft lip based upon the original graphic depicting canonical anatomy.

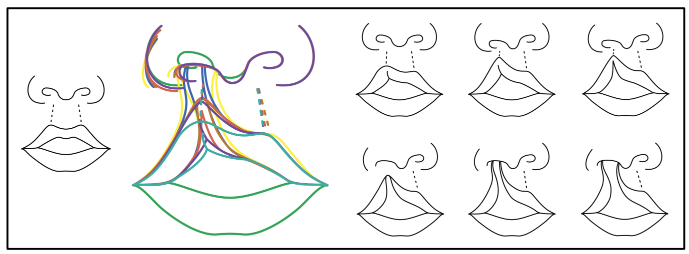

Fig. 1. Strategy for creating the graphics library. Beginning with the vector line drawing of the canonical lips and nose, lines were added to represent different severities of clefting.

A total of 46 graphics were developed to represent malformations of the lips. These include unilateral, bilateral, and midline clefts of varying severity for the upper lip, as well as cleft lower lip and lower lip pits. A portion of the library, matched to classes in the CHO, is shown in Figure 2. The library is available for download at http://melissaclarkson.com/resources/cleft_lip_graphics.

The preliminary graphics library for development of the human head from stages 12 through 23 is shown in Figure 3. Each point in the time series is depicted from anterior, oblique, and lateral views. This library can serve as the basis for visually defining parts of the developing head represented in the CHO.

IV. Conclusion

These graphics have played an important role in supporting discussions within the Structural Informatics Group during development of the OCDM, and also in communicating with researchers outside the group. In addition, the process of developing these libraries has revealed gaps in both the knowledge of individual domain experts and the collective knowledge of the field of human development.

Because SVGs can be manipulated by web browsers, these graphics provide as a mechanism for exploring how graphic libraries can be used within applications of knowledgebases to create on-demand or customized graphics.

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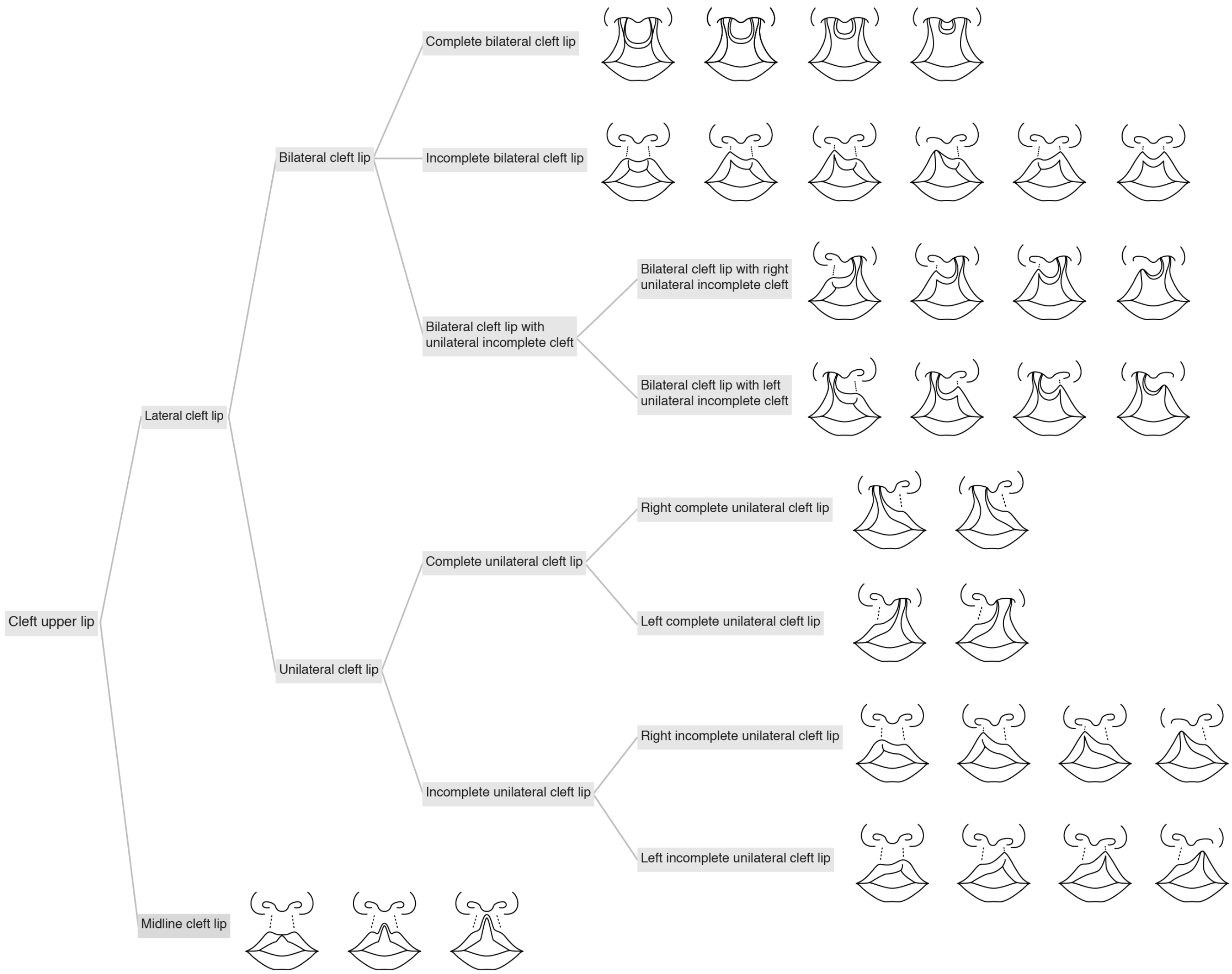

Fig 2. Graphics of cleft lip matched to classes of the CHO. The graphics clarify that each class represents a small range of phenotypes.

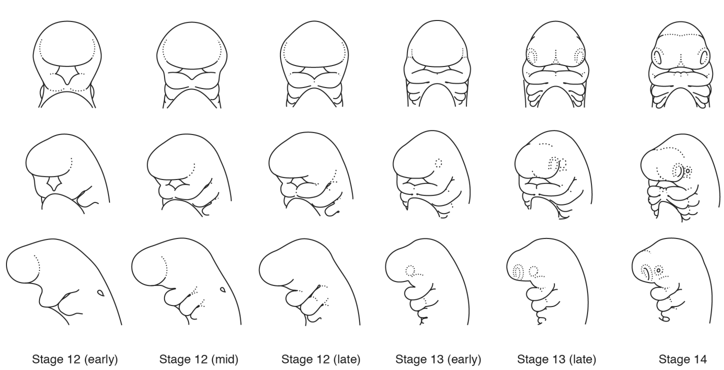

Fig 3. Preliminary graphics for stages 12 through 14 of development of the human head. Anterior, oblique, and lateral views are provided for each time point.