the skin, cutting into the flexor and extensor tendons and indenting the distal radius. The elastic band was removed and the area was debrided. The patient’s postoperative course was uneventful. Her culture grew Streptococcus, and she was given penicillin. She had good hand function at the 6-month review.

We report this case to highlight the importance of eliciting a proper history and to generate awareness of this condition.

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Updated Embryology of the Upper Limb

To the Editor:

The recent review on limb development1 nicely summarized current knowledge on the etiology of congenital hand defects. The article may be further served by a discussion of a fundamental shift in current thinking for how proximal-distal patterning of the developing limb occurs.

The article describes the progress zone model of development (Fig. 1B) as the primary mechanism of proximal-distal patterning of the limb. This model is based on experiments in which the apical ectodermal ridge (AER) of the limb bud was removed at progressively later stages of development. Earlier removal led to severe limb truncations, whereas later removal led to the loss of progressively more distal structures.2 The interpretation of these experiments was that the AER provides a signal that keeps cells in an uncommitted state. As the limb bud expands, cells would leave the progress zone and differentiate, but those that stayed longer would remain more distal.

Revisitation of these experiments with current molecular and genetic techniques has led the progress zone model to become seriously questioned. For example, AER removal has now been shown to have a profound effect on underlying mesenchymal cells.3 Early removal causes a zone of cell death that, owing to the small size of the limb bud, removes both distal and proximal limb progenitors (as assessed by lineage tracing), whereas later removal in a larger limb bud only affects the distal progenitors. In addition, selective genetic removal of the molecular signal of the AER in the limb bud (fibroblast growth factor) does not lead to transverse deficiencies as predicted by the progress zone model. The limbs of these embryos developed distal-most structures, and more strikingly, they still had distal structures even while displaying reductions in more proximal structures.4 These experiments led to a model of proximal-distal patterning known as early specification (Fig. 1C), in which all compartments of the developing limb are specified early in development and then expand with growth.

Genetic experiments as well as further experiments using in vitro culture of limb buds treated with various molecular inhibitors and reimplanted back into the embryo supported a further variation of this model in which 2 signals specify proximal and distal identity (Fig. 1D): the proximal signal is proposed to involve retinoic acid signaling and the AER-derived signal involves fibroblast growth factor signaling.5,6 These new perspectives on proximal-distal patterning provide not only new insights into the cause and classification of congenital defects, but also a basis upon which to study limb repair and regeneration.

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FIGURE 1: A The limb bud emerges as a bud of mesenchyme encased in an ectodermal hull. Patterning is required to establish the different proximal-distal compartments of the limb, as denoted by the color coding. How this patterning arises has been proposed to occur via 3 different models, as illustrated in B through D. The first model B, the progress zone model, has been called into question.

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http://dx.doi.org/10.1016/j.jhsa.2014.01.048

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