

Polydactyly

Introduction

Polydactyly (PPD) is one of the most frequently observed congenital hand malformations with a prevalence of 2 per 1000 live births (Sun, et al., 2011). There is a surplus of classification types with various manifestations. Its genetic basis lies in mutations within pathways such as the sonic hedgehog (SHH) pathway which affects foetal limb development and specifically digit development. Mutations causing polydactyly have also been associated with other disorders such as Werner's mesomelic syndrome and dwarfism. Diagnostic techniques are available as well as treatments consisting of various imaging techniques i.e x-ray and surgical procedures respectively.

Digit development and limb polarization

Digit number and identity is regulated by mechanisms that initiate polarity of the limb bud. Complementary expression of transcription factors Gli3 in the anterior half and HAND2 in the posterior half of the limb bud are first molecular indications of limb polarity, this predisposes the posterior region of the limb bud to express the SHH gene (Figure 1). The SHH gene is expressed at the posterior margin of the limb bud termed the zone of polarizing activity (ZPA). SHH signal regulates proteolytic processing of Gli proteins, specifically Gli3. Gli3 is expressed across the limb bud, where SHH concentrations are high, it is present in its activator form Gli3A; by contrast, in the anterior where Shh is low or undetectable Gli3 is processed into the repressor form Gli3R (Wilson and Chuang, 2010). This relative concentration of Gli3A:Gli3R across the developing limb bud specifies the differences between fingers. SHH, secreted by the ZPA, also mediates digit specificity due to its morphogenic effect creating a French flag threshold concentration (figure 2).

