there is a group of “dental genes” that not only influences the size and shape of teeth but also the expression of missing or extra teeth. In other words, there are both pleiotropic genetic effects operating on the human dentition and spatial and/or temporal variations in local epigenetic events during odontogenesis that lead to distinct phenotypic differences in the dentition, even in genetically identical twin pairs.

Genetic, epigenetic and environmental influences on dental development

Twin models

We agree completely with Professor Carels that studies of twins have contributed greatly to our understanding of the role of genetic and environmental influences on dental development. However, the traditional twin approach involving comparisons between monozygotic (MZ) and dizygotic (DZ) twin pairs requires large samples and is based on assumptions that may not always be valid.

There is a simpler research model involving twins that can also be employed by practising dentists. This model is referred to as the MZ co-twin design and it essentially involves studying pairs of MZ twins who may have different habits, receive different treatments, or differ in expression for one or more features of interest. Because each MZ pair is matched for sex, age and genetic make-up, the co-twins provide an extremely valuable research model. For example, just one pair of MZ twins displaying differences in their dentitions offers a great opportunity to explore the underlying biological processes of tooth formation.

Given that MZ twin pairs almost always share the same genes, any differences observed between the members of an MZ pair are assumed to be due to differences in environmental effects between the co-twins or to the way in which their genes are expressed, that is, epigenetic effects. The MZ pairs described in this article have a very high probability of being genetically identical based on DNA analysis. Further-

more, there is no evidence in their records of major differences in environmental influences, either pre-natally or post-natally. Therefore, the differences between these co-twins could have been caused by epigenetic differences in the control of their DNA and/or by relatively minor variations in local environmental conditions during the process of odontogenesis.

Fig. 2. MZ co-twins showing different expressions of missing, tapering and small maxillary lateral incisors.

Fig. 3. MZ co-twins showing different expression of missing and small maxillary lateral incisors. Twin A displays agenesis of the maxillary right lateral incisor and a small maxillary left lateral incisor, whereas Twin B has two small maxillary lateral incisors. The mandibular premolars had been extracted for orthodontic reasons.

Fig. 4. MZ co-twins showing different expression of missing and tapering maxillary lateral incisors. Twin A displays bilateral agenesis of the maxillary lateral incisors, whereas Twin B has a tapering maxillary right lateral incisor and a missing maxillary left lateral incisor.

Fig. 5. MZ co-twins showing different expressions of missing lower second premolars and third molar development.

Fig. 6. MZ co-twins showing different expressions of supernumerary teeth.