

## 17

# Curved Canals

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Numerous studies of the anatomy of the root canal system have abundantly demonstrated that they are rarely straight and that even when they do appear so by intraoral radiography, in reality they almost never follow the linear direction suggested by their two-dimensional radiographic image. The upper lateral incisors, which according to Ingle<sup>9</sup> have the second highest failure rate of all the teeth of the two dental arches, very often have a palatally-directed curvature in the apical third; therefore, it is not appreciable radiographically. The mesiobuccal canal of the lower first molars often has a curve directed distally, which can be appreciated radiographically, but a buccolingually-oriented curvature is also frequently concealed, as it cannot be demonstrated radiographically.

Almost all the canals, then, have curvatures on many planes. These curvatures should always be suspected, even when the radiograph fails to demonstrate them. They require care and attention, which will vary according to the site. One may distinguish curves of the apical, middle, or coronal third, each of which requires particular treatment. Even though the preparation of curved canals is much easier with the use of nickel titanium instruments, taking into consideration the fact that the suggested technique is a combined technique, using hand and subsequently rotary instruments, and also considering that sometimes the apical curvature can only be prepared with stainless steel hand instruments, for all these reasons it is still useful to discuss the hand preparation of curved canals.

## CURVES OF THE APICAL THIRD

These curves must be absolutely respected and never straightened, even minimally (Figs. 17.1, 17.2, 17.3). Straightening these curves would mean displacing the

apical foramen from its original position and altering its shape. This is an extremely serious error that will lead to certain treatment failure. Displacement of the apical foramen leads to three errors: first, “direct perforation”, which occurs when a straight, large-size instrument perforates the root surface at a point other than the anatomical foramen (Fig. 28.60 D); second, “ledges” or “false canals,” which consist of the formation of a new canal which branches off tangentially to the original canal, but does not perforate the root (Fig. 17.4); and third, the creation of a “teardrop foramen” (Fig. 17.5), with all the complications associated with the obturation of such an apical orifice (see Chapter 14).

Preservation of the curve of the apical third is assured by always starting the cleaning and shaping of this segment of the root canal with small, precurved instruments, such as a # 08 or 10 K-type file. The precurvature should reflect the degree of apical curvature of the canal being treated. The instrument should not be worked until the radiograph confirms that it is exactly at the radiographic end of the canal. Once this is verified, one may begin to work it, but always bathed in sodium hypochlorite, with small excursions of fractions of a millimeter. The small excursions serve to limit the precurved portion of the file to working in the curved portion of the canal and thus to preserve the precurvature that it has been given as much as possible. If instead one used large excursions, the precurved portion would pass alternately from the curved to the straight portion of the canal, and the instrument would lose its precurvature. It would straighten out, and, as noted above, this would predispose to transportation of the apical foramen.

Nonetheless, even if one is careful to use small excursions, the instrument tends to straighten out. It is therefore necessary to withdraw it from the canal periodically, clean it, and re-curve it before re-introdu-

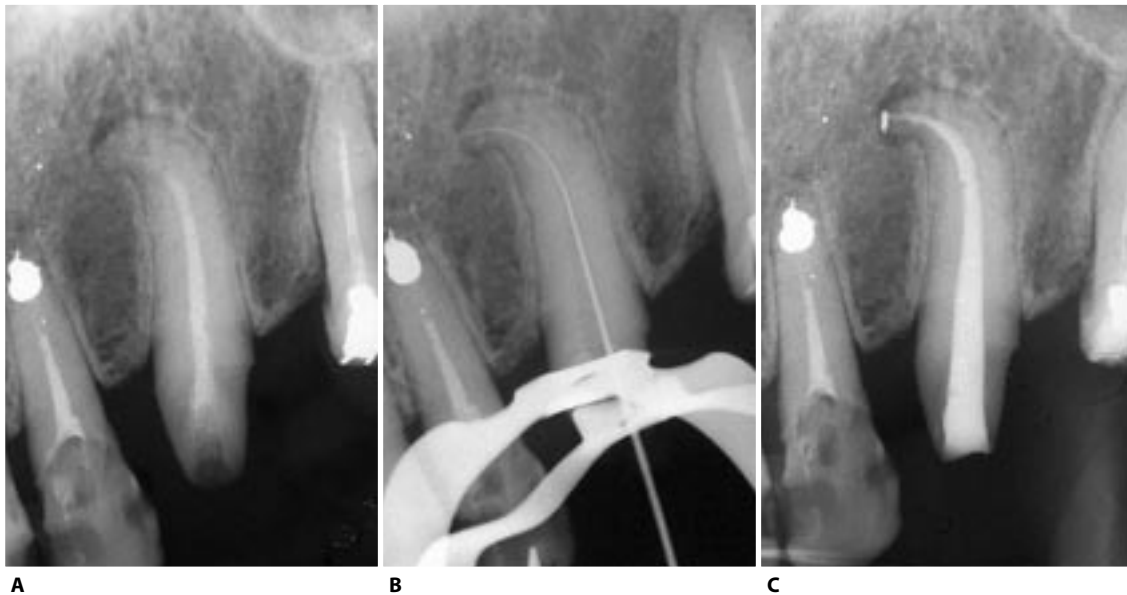


Fig. 17.1. An upper left canine with an apical curve of about  $90^\circ$ , cleaned, shaped and filled according to the Schilder technique. **A.** Preoperative radiograph. **B.** Intraoperative radiograph. Note that, at the time of measurement of the working length the enlargement of the middle and coronal thirds of the canal had already been performed with the aim of achieving easier access to the apical curvature. Early enlargement of the coronal two-thirds of the canal is documented by the complete removal of old obturation material. **C.** Postoperative radiograph. Note the preservation of the position of the apical foramen.



Fig. 17.2. A lower left third molar with an apical curve of about  $90^\circ$  in the distal root. **A.** Intraoperative radiograph. **B.** Postoperative radiograph. **C.** Two year recall (Courtesy of Dr. M.J. Scianamblo).