Design Considerations

17. What are the most important relationships of the components of file designs and canal anatomies that enable us to improve our technique?

Careful examination of technique and design considerations identifies the limitations and usefulness of existing instruments and facilitates the development of a new generation of rotary instrumentation, one unencumbered by traditional concepts. A few all-important consequential relationships of different file designs and tooth anatomies can facilitate understanding how files function. Although research on endodontic instruments cannot determine with absolute certainty how files will react under all circumstances, research can result in inferences having significant predictability that can be used as considerations for instrument and technique design. The following are some of the considerations and ramifications of designs that are most important in formulating techniques in approaching difficult cases:

1. A file with a more **efficient** cutting design requires less torque, pressure or time to accomplish root canal enlargement.
2. In a **straight canal**, the ability of a file to withstand torque is related to the square of its diameter.
3. In a **curved canal**, the ability of a file to resist fatigue has an inverse relationship with the square of its diameter.
4. The torque required to rotate a file varies directly with the **surface area** of the file's engagement in the canal.
5. Fatigue of a file increases with the **number of rotations** of the file in a curvature.
6. Fatigue of a file increases with the **degree of curvature** of the canal.
7. To improve efficiency, the smaller the surface area of a file engaged in the canal, the greater the **rotation speed** should be.
8. The **more spirals** a flute has per unit length around the shaft of a ground file, the less resistance to torsion deformation there is but the more flexible the file is.
9. The **fewer spirals** a flute has per unit length around the shaft of a ground file, the more it resists torsion deformation but the more rigid it is.
10. The **sharper the cutting blade** of a file, the fewer spirals per unit length the file should have.
11. The greater the number of flutes with **similar helix angles**, the greater tendency a file has to screw into the canal and become bound.
12. Maximum engagement of a file occurs when it progresses into the canal at a rate that is equal to its **feed rate,** the rate the file progresses into the canal without the application of positive or negative pressure.
13. Less canal transportation occurs with a file having greater flexibility, an **asymmetrical cross section** design, and/or a land.