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Restoration of the Endodontically Treated Tooth

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INTRODUCTION

The current endodontic techniques which are ever more conservative and sophisticated\(^{29,165}\) have increased the potential longevity of endodontically treated teeth. However, in order for this to take place, it is the responsibility of the clinician, who carries out the restoration, to make the correct choice of restorative materials and techniques indicated for the various situations. The difficulty, often, is not to “work well” from a technical point of view, but to know case after case which treatment is best indicated without incurring errors by mistake such as not adequately protecting the tooth from fracturing, or in excess by placing a post that is not necessary. The techniques and materials that are currently available allow for the recovery of extremely compromised clinical situations, but it is essential to know how to evaluate a procedure which falls into the group of “therapeutic obstinacy” and whether the relationship between biological cost and benefit is favourable. The restoration of endodontically treated teeth with severe loss of structure is often a complex procedure which requires a profound knowledge of endodontics, periodontics, prosthodontics and restorative dentistry. For the clinician it is not always easy to formulate the correct treatment plan, because the proven and unequivocal scientific guidelines are often lacking. The clinician has to know how to evaluate, before carrying out the treatment plan, whether this will be adequate with regards to the duration of the tooth with respect to the general oral condition of the patient, without creating damage to the other teeth. In the case of restoring a severely compromised tooth, one has to be able to propose an alternative treatment, which may involve extraction and replacement with an osseointegrated implant.\(^{143,146}\)

The aim of this chapter is to describe the criteria that form the basis of the specific reconstructive procedures for an endodontically treated tooth to ultimately obtain an adequate rate of success.

HISTORY

In 1747 Pierre Fauchard,\(^{65}\) founder of modern dentistry, used gold and silver posts to anchor single teeth or bridges to roots of anterior teeth. These posts were cemented with a rubber solution, lacquer, powdered coral and turpentine, which was then heated to make it adhesive. At the time the implanted teeth were of various materials: ox or hippopotamus teeth, human teeth, ivory, bovine bone and so on. Successively these materials, quite unusual to us, were substituted with porcelain. In 1839 Chapin Harris\(^ {92}\) described the method of reimplanting artificial teeth with posts into roots as “the best one could do”. For many years the material used for these first rudimentary posts was wood, that due to the damp conditions expanded and became very retentive. One must remember (see Chapter 1) that endodontics in those years were just starting and so the metallic or wooden posts, which ever used, were positioned in canals that were completely empty with all the imaginable endodontic problems that subsequently occurred. The metallic posts at that time were less successful because adequate cements were not available. Therefore they were subject to notable corrosion processes and the internal movement in the canal often caused wear or fracture of the root in which they were placed.

Undoubtedly, compared to the work of these dental pioneers, the techniques and materials have greatly evolved and currently a predictably successful en-
endodontic technique is widely used giving the clinician an ever increasing number of endodontically treated teeth to restore optimally, both functionally and aesthetically. According to Tidmarsh,203 from the patients point of view, success depends on both the endodontic as well as the restorative technique to restore the tooth functionally but also aesthetically.

BIOMECHANICS

A general consensus exists that considers the endodontically treated tooth more fragile and more susceptible to fracture than a vital tooth. In reality, what differentiates one from the other and why must particular caution be exercised when restoring these teeth?

In the past much research was carried out to verify the effective differences between a tooth with a vital pulp and one which was endodontically treated (Fig. 35.1); the loss of water was studied,18, 94,156 the hardness,84,37 the ultrastructure of the tropocolagen,169 the architectural modification,85,182 and the loss of proprioceptors 164 of endodontically treated teeth was studied, often obtaining results that were completely in antithesis. Vice versa all the authors were completely in agreement on attributing great importance to another parameter: the loss of tooth structure due to caries, fractures, external and internal resorption, restorative procedure, endodontics and prosthetics. In 1994 Assif 13 re-examined the literature of this subject and concluded that teeth subjected to endodontic therapy have not changed with regard to their modulus of elasticity,74 their hardness or fracture resistance.210 However, the more tooth structure that is lost, creates a lower resistance to physiological occlusal loading 184 and the higher the risk of fracture.141,116,180,98 On this point researchers all agreed and confirmed that as soon as a tooth loses its integrity, even if only a small amount of tooth structure, its resistance against loading starts to reduce. In 1989 Reeh, 167 using deformation detectors on a series of premolars, found that endodontic treatment alone reduces its strength maximally by 5%, while the preparation of a class two cavity, with the consequent interruption of the marginal crest, reduces the strength by 20% and an MOD cavity type is reduced by 63%. The scientific literature concords on this point that the interruption of both opposing marginal crests corresponds to a reduction in the tooth’s strength (Fig. 35.2) with a dangerous increase in fracture risk. Confronted with this event, the fracture line in a tooth with an intact pulp chamber, would mostly follow a horizontal path with a coronal involvement, while in the endodontically treated tooth the origin would be more apical 111 and the path mostly vertical with a radicular involvement, thereby making this tooth a candidate for extraction (Fig. 35. 3). A root fracture having a mostly vertical direction mostly vertical is the preferential route for bacteria to penetrate deep into the periodontium with consequent progressive bone resorption (Fig. 35. 4). One should remember that a fracture can be present with the tooth structure intact due to the kinetic effect of excessive

Fig. 35.1. A. Histological preparation of a molar. B. Endodontically treated and diaphanized upper premolar (Courtesy of Dr. Arnaldo Castellucci).