9. BIOMATERIAL AND BIOMECHANICAL CONSIDERATIONS IN THE
DEVELOPMENT OF COMPOSITES FOR THE RESTORATION OF
POSTERIOR TEETH

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1. INTRODUCTION

Although materials had been in use for many centuries for the resto­
ration and replacement of teeth, it was not until the early nineteenth century
that any progress was made in the development of materials really suited
to intra-oral use. Several of our currently used materials had their origin
at that time as by-products of the Industrial Revolution. Among these
materials was amalgam.

Tin and lead had been used for fillings for several years and early
in the nineteenth century, Fox used a fusible alloy of lead, bismuth and
tin for this purpose. This led to the formulation of silver amalgam by
Bell in 1819 and Taveau in 1826 in Europe. It was introduced into the
United States in 1833, not without criticism and controversy over it's
safety in relation to mercury toxicity. Lacking many of the characteristics
we demand today, it was certainly not the ideal filling material and
improvements were made by Townsend and Flagg and, most notably by G.V. Black,
who refined the alloy composition and determined the optimum handling
characteristics to give the best clinical performance. There were few
changes to amalgam from Black's time, in the 1980's, to the 1970's but
since then there have been some radical changes in amalgam composition,
presentation and performance.

This material has stood the test of time better than most dental mat­
erials and there are many practitioners who regard the highly-polished,
good-looking amalgam restoration with pride and satisfaction.

In recent years, however, two of the features of amalgam have come
under close scrutiny and considerable pressure has been exerted on the
dental profession to develop an alternative filling material for posterior
teeth. The first of these is the potential toxicological hazard associated
with mercury, the subject of a controversy lasting over 150 years(1).
In my opinion this is a grossly overstated problem and does not provide the real stimulus for change, but we have to recognize these pressures, more political than scientific that are exerted from both within and outside the profession. The second concerns the widely expressed fear that there will be a shortage of some of the metallic materials used in amalgam in the near future. Such fears again defy the facts but yet still persist. Even though these two reasons are not particularly valid there has undoubtedly been a continuing and increasing demand for the development of alternatives to amalgam, the underlying reason being the need, in this aesthetic age, to have a filling, even in the back of the mouth, that looks like a tooth rather than a piece of metal. It is easy to predict that once a tooth-coloured material with properties proven to be equal to those of amalgam becomes available every patient will ask for it, and few dentists will deny them.

The purpose of this review is to define the characteristics of the ideal posterior tooth-coloured filling material and to describe the efforts that have been made during the last few years to produce a material that matches these requirements as closely as possible.

2. THE IDEAL TOOTH-COLOURED POSTERIOR FILLING MATERIAL

It is traditional practice in the teaching of dental materials science to define the requirements of any class of material before discussing the specific materials that are available (2). In many situations, and certainly in the present case, we may divide these requirements into two categories, those concerned with clinical handling of the material and those concerned with the intra-oral use of the set material.

2.1. Clinical handling

Although in all applications of biomaterials the manner in which the materials and devices are handled clinically is of importance, rarely does this take on such a significance as it does in restorative dentistry. The underlying reason for this is restorations have to be made individually, to fit individual and unique cavities in individual patients. There is no question of mass production as with hip prostheses or heart valves. This means that the dental practitioner is both maker and user of the material rather than simply the user of a prepackaged product. The manner in which pastes, or powders and liquids are mixed, and factors such as ambient