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Polishing Porcelain

A Note on New Rotary Abrasive Tools

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SUMMARY

Recently developed rotary abrasive tools for polishing ground dental porcelain are discussed. The efficacy of the tools was assessed by scanning electron microscopy and by surface roughness measuring.

OPSOMMING

Wentelskuurinstrumente wat onlangs ontwikkel is vir die polering van geslypte tandheelkundige porselein, word bespreek. Die doeltreffendheid van hierdie instrument is deur skandeer elektronmikroskopie, asook deur die meting van die oppervlaksgrofheid, bepaal.

INTRODUCTION

For some time past the surface characteristics of tooth-coloured filling materials, both trimmed and untrimmed, have been the subject of reports in the dental literature (Fusayama *et al,* 1964; Fusayama, Miyazawa and Hosoda, 1966; Bergvall, Brännström and Wictorin, 1971; Mueller, Bapna and Wayman, 1971; McLundie and Murray, 1972). Studies have shown that the instruments commonly used for finishing restorations are not capable of producing a smooth surface on tooth-coloured filling materials. The particular difficulties of finishing trimmed composite resins have, therefore, attracted attention (Valcke, 1971; Johnson, Jordan and Lynn, 1971; Chandler, Bowen and Paffenberger, 1971). In an examination of the suitability of various abrasive discs for this purpose the usefulness of one of these discs for polishing ground porcelain was also investigated and reported to be sufficiently effective to eliminate the need for reglazing the ground surface (Chandler *et al,* 1971).

The purpose of the present investigation was to assess the smoothness of polished porcelain surface produced by tools* which have recently become available to the profession.

The tools were also originally developed for use in finishing composite resins. They are wheelshaped and are made in two sizes, namely, 1,2 cm and 1,7 cm in diameter, and are about 2 mm in thickness. They consist of a synthetic rubber material, impregnated with various abrasives. The larger wheels are coarser than the small ones. The ground porcelain surface is first smoothed with the coarser or larger wheels and then polished with the finer ones. According to the manufacturers the wheels are most effective at speeds of 12,000 to 18,000 rev/min and should be used with the application of moderate pressure. Care must be taken to move them constantly across the ground surface, not allowing them to act in one place for any appreciable time, as this causes grooving of the porcelain. Thus, a wheel is allowed to operate in one direction and is then re-applied at right-angles to the original direction.

MATERIALS AND METHODS

In the first instance vacuum-fired porcelain upper central incisor teeth, including porcelain fused to gold crowns and commercial denture porcelain teeth, were employed for the study. A facet was ground on one half of the labial surface of the specimen and the facet was then polished, using the abrasive wheels. These specimens were examined in a scanning electron microscope.

Subsequently a slab of vacuum-fired porcelain** approximately 2 cm long and 1 cm wide was baked in a porcelain investment mould. The glazed surface

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of the porcelain was then ground over two-thirds of its area, using a coarse cylindrical abrasive point and subsequently half of the ground area was polished with the abrasive wheels. Thus the prepared specimen had a surface showing, at one end, the original glaze, at the other end, the polished area, and, in the centre, a ground area (fig 1). The surface of the specimen was then examined with a Taylor-Hobson Talysurf Model 3 surface roughness measuring machine which makes it possible to make a quantitative assessment of the surface roughness.

RESULTS

Scanning electron micrographs of the ground and polished teeth showed a smooth surface with a few linear scratches and occasional defects due to porosity of the porcelain (fig 2). These micrographs were considered relatively uninformative. On the other hand the porcelain specimen which was examined with the surface roughness measuring machine showed that no appreciable surface defects were evident in either the glazed or polished areas (figs 3 and 5). In contrast to this the trace of the central (ground) area showed marked surface irregularities, some were of the order of four micrometres (fig 4). In figs 3, 4 and 5 the horizontal magnification is 100 x and the vertical magnification 1000 x. The distance between the straight horizontal lines therefore represents two micrometres.

DISCUSSION

The surface finish of porcelain used in various types of prostheses is important for a number of reasons, including cosmetic and hygienic considerations. The roughness of the surface leads to staining and permits food stagnation. A rough porcelain surface is also abrasive and may wear opposing enamel, dentine or restorative materials. Moreover, it influences the physical strength of the material because stress concentrations may occur in surface irregularities.

Glazing imparts a smooth surface finish to the porcelain. When a porcelain restoration is adjusted by grinding, the surface should be re-glazed in order to obtain a smooth surface. However, the need to return the porcelain to the furnace limits the practicability of the re-glazing process.

When porcelain has been ground the surface finish may be improved by the use of abrasives. In the case of the abrasives under consideration the six specimens on which facets were ground and then polished had a naked-eye appearance very similar to that of glazed porcelain. Examination with the scanning electron microscope at magnifications of 20 x to 50,000 x made it possible to estimate the length and breadth of surface irregularities, but not their depth. It is for this reason that the scanning electron micrographs were considered relatively uninformative. In contrast to this the machine used for surface roughness measuring of the specimen demonstrated the depth of the irregularities in the ground area and showed that the finish in the polished area was comparable to the original glaze.

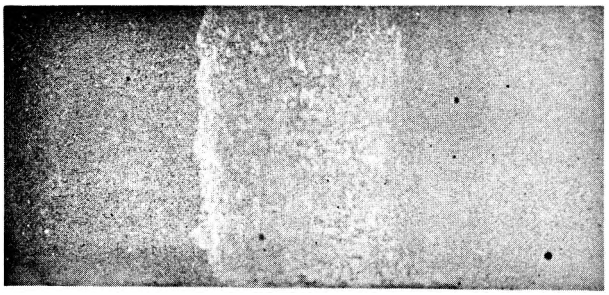


Fig. 1. Surface of porcelain specimen (2 cm x 1 cm).
Left - glazed area
Centre - ground area
Right - polished area (note porosity).

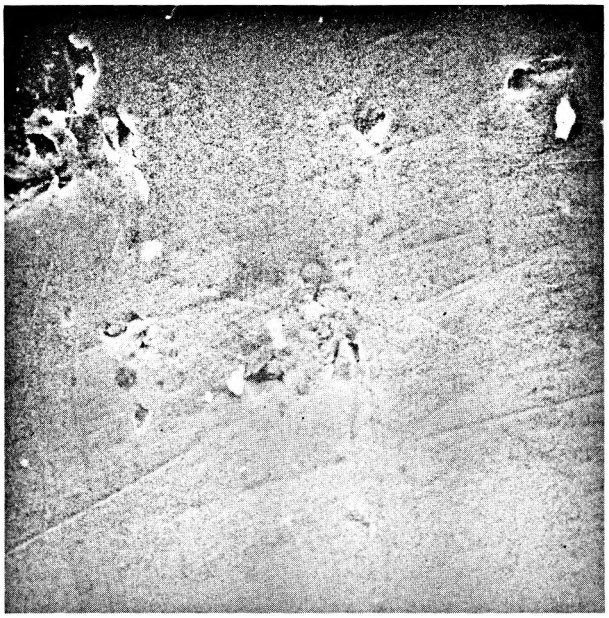


Fig. 2. Electron micrograph, polished commercial denture tooth, showing porosity. Area shown 100 x 100 micrometres.

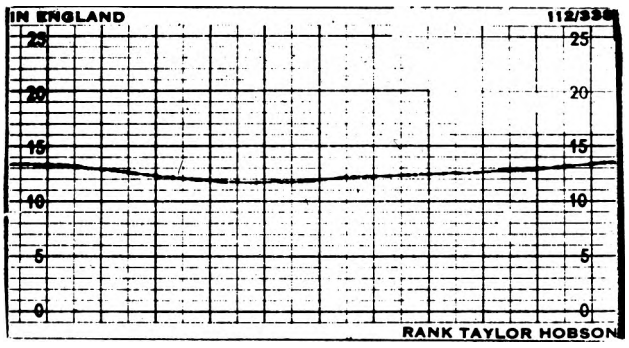


Fig. 3. Trace of glazed area in fig 1 produced by surface roughness measuring machine.

Defects in a ground porcelain surface due to porosity can only be eliminated by re-glazing and no amount of polishing with abrasives can improve a porous porcelain. However, a dense porcelain can be restored to an acceptable finish after grinding.

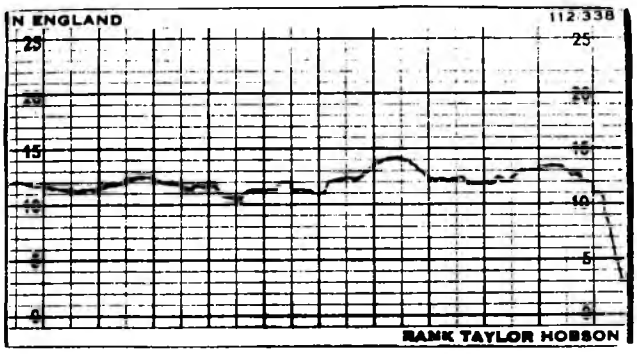


Fig. 4. Trace of ground area in fig 1 produced by surface roughness measuring machine.

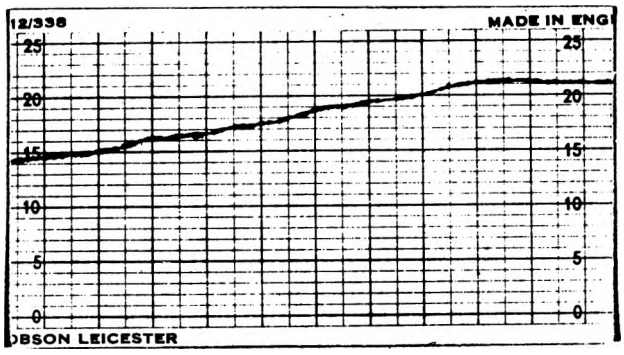


Fig. 5. Trace of polished area in fig 1 produced by surface roughness measuring machine.

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