

The Quality of Impressions for Crowns and Bridges: An Assessment of the Work Received at Three Commercial Dental Laboratories. Assessing the Quality of the Impressions of Prepared Teeth.

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Abstract - The literature is limited in studies directly assessing the quality of impressions for crowns and bridges in the UK. The aim of the study was to assess the quality of impressions for conventional crown and bridgework received by commercial dental laboratories. Three dental laboratories were visited over a 3-month period. All impressions for conventional crowns and bridges that arrived on the days of the visits were examined prior to any laboratory processing. A total of 206 impression cases were examined and assessed against criteria laid out in a custom-designed assessment form. Defects were commonly found in the recording of prepared teeth. Overall, 44.2% of impression cases were unsatisfactory. NHS impressions were more than twice as likely to be unsatisfactory compared to private impressions. If the results of this survey are typical then the general quality of impressions for fixed crown and bridgework is unacceptable. This is particularly true for work completed under the NHS contract.

KEYWORDS: Impression, Crown, Quality

INTRODUCTION

An essential element in the production of high quality indirect dental restorations is the ability to accurately and precisely record dental structures. Although intra-oral scanning devices are now available (e.g.Lava™ Chairside Oral Scanner, 3M Espe), their use is currently rare, and a variety of impression materials and techniques are generally used to achieve this aim.

The production of an accurate impression is dependent on several factors. The soft tissues will need careful and appropriate management, the tooth preparation itself should be precise with clearly discernable finishing lines, and the impression should be faithfully recorded using appropriate impression materials and techniques.¹ It is therefore necessary for the dentist to critically evaluate the impressions recorded before dispatching them to the laboratory for processing. In this way clinically detectable errors in the impressions can be corrected and only impressions of a satisfactory standard to enable the production of high quality restorations are dispatched to the laboratory.

The existing reports of the standard of impressions received by dental laboratories for the construction of fixed restorations reveal that a high proportion of the impressions have deficiencies in several regards¹⁻⁶. The most common in all these studies is the inadequate recording of the margins of the prepared teeth with 36% of impressions in a UK survey having deficiencies in this respect.³ Christensen^{7,8} subjectively

reports that the same problems exist in the United States, with indistinctly reproduced margins in the impression being commonplace and requiring the dental technician to guess the true position of the margin if a restoration is to be produced.

Thus, while the properties of modern impression materials have been extensively described^{9,10,11} along with appropriate techniques and situations for their use^{10,11,12}, a review of available literature consistently reveals concern over the quality of impressions made by dental practitioners for the construction of fixed conventional crown and bridge work.

The purpose of this investigation was to visually inspect the impressions sent to three commercial dental laboratories for the fabrication of conventional crown and bridge restorations in order to determine the presence and frequency of clinically detectable faults within the impressions. A further aim was to compare the quality of impressions carried out under either NHS or private contract.

This paper will limit its observations solely to the quality of the impression of the prepared teeth.

METHODOLOGY

Three commercial dental laboratories were selected due to their varied client. These laboratories were visited on randomly chosen days over a four month period between January and April 2010. All impressions that were received by the dental laboratories taking part in the audit that requested conventional crown and bridge work were examined on the days on which the author visited the laboratories. These three laboratories are designated Laboratory A, B and C.

As only the impressions were to be examined, and not the casts of the impressions, inlays/onlays and veneers were

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Table 1. *Classification Criteria*

	<i>Reason For Classification</i>	<i>Specific Features Assessed</i>
Impression Definitely Satisfactory	Impression clearly records tooth preparation.	<ul style="list-style-type: none"> Clearly defined and continuous margins exhibiting no imperfections. Absence of voids, drags or tears in the rest of the preparation.
Impression Probably Satisfactory	Minor faults present that can be overcome by the judgment of a trained technician.	<ul style="list-style-type: none"> Small inclusions at the margins. Small losses of marginal integrity (less than 1mm). Minor imperfections in the remainder of the impression of the prepared tooth.
Impression Unsatisfactory	Significant faults requiring guesswork by the technician if a die is to be produced.	<ul style="list-style-type: none"> Complete loss of marginal definition greater than 1mm. Extensive voids, drags or tears within the impression of the preparation.

excluded from the study due to potential problems in visually determining the integrity of the finishing lines in the impressions. To avoid confusion, any case involving multiple preparations was counted as one case, and if a defect was found present in only one of the preparations the case was judged according to the defect found. All of the three laboratories chosen to take part in this study receive the full range of fixed restorative work, although one laboratory, Laboratory A, received work undertaken under private contract only.

Protocol for Inspecting Impressions

To aid the examination of the impressions an assessment form was developed to give a structured assessment protocol. This was designed to be largely objective targeting mainly factual issues such as impression tray type, impression material used and impression technique. Each impression was examined for the presence of blood or debris, and for evidence of disinfection, although in practice this proved difficult to assess. Each impression was also examined to see if it was firmly fixed to the impression tray. The impressions of the tooth preparations were inspected for defects. The finishing lines of the preparations were examined for air blows, drags or tears that would prevent an accurate interpretation of the true position of the margin of the restoration. The remainder of the impression of the preparation was examined for defects that could potentially compromise the fit of a subsequently fabricated restoration.

Assessment of Impression Quality Relating to Tooth Preparation

The quality of the tooth preparations were not being assessed in this study. The working impressions received for each case was assigned one of three categories depending on whether or not a satisfactory die could be produced on which a restoration could be provided for the patient undergoing treatment (Table 1). These are:

1. Definitely satisfactory.
2. Probably satisfactory.
3. Unsatisfactory.

Only clinically detectable errors were taken into account in gathering the data for this study.

Table 2. *Number of impression cases examined at each laboratory.*

	<i>NHS n (%)</i>	<i>Private n (%)</i>	<i>Total NHS +Private n (%)</i>
Laboratory A	0 (0)	40 (100)	40 (100)
Laboratory B	26 (38.2%)	38 (55.9%)	68 (100)*
Laboratory C	11 (11.2%)	87 (88.8%)	98 (100)
Laboratories A+B+C	113 (54.9%)	89 (43.2%)	206 (100)*

(* 4 cases from Laboratory B did not specify whether the work was to be done under NHS or private contract and are included in this total)

RESULTS

The total number of impressions examined was 206. Of these, 4 cases did not specify whether they were to be done under NHS or private contract. They have therefore been included in the overall assessment of impression quality but excluded when assessing NHS or private work specifically.

The breakdown of the 206 impression cases between the different laboratories and between NHS and private work is detailed in Table 2.

The Working Impression

Of the 206 working impressions examined silicone was used in 198 (96.1%) cases. Impregum (polyether) was used in the remaining 8 cases. Nineteen dual-arch impressions were examined of which 2 were taken without the use of trays. These consisted simply of a ball of silicone putty through which the patient closed into centric relation after having light bodied silicone syringed around the prepared tooth. The remaining 17 dual-arch impressions used trays and more conventional techniques. Sixteen of these were made in silicone using single stage putty-wash technique and one was made using polyether (Impregum) and monophase technique. All the other working impressions examined were full arch, partial arch, or sectional impressions. They totalled 187 impressions. Polyether (Impregum) and monophase technique were used in only 7 cases. Putty-wash techniques were used in 174 cases with a one-stage technique being used in 144 cases and a two-stage technique in 30 cases. One custom tray impression was recorded using a one-stage putty and wash technique. Dual-phase (heavy/light bodied silicone) was employed as a technique in 3 cases, twice in combination with metal stock trays and once with a special tray.

Quality of Impression of Prepared Teeth

Overall, the number of working impressions which demonstrated clearly visible and intact finishing lines (margins) on the prepared teeth was 99 (48.1%). A further 16 (7.8%) would probably be satisfactory after minor adjustment by the technician. However, 91 (44.2%) demonstrated faults at the margins that rendered the impression unsatisfactory for the production of a restoration. Such faults included large air blows or complete loss of marginal definition, typically due to poor soft tissue management but often compounded by poor tooth preparation. Examples of the impressions inspected are shown in Figures 1a, b and c.

The rest of the impression of the prepared teeth was also examined for blows, drags or tears that would compromise laboratory work. In total, 173 cases (84%) were clear of visible defects in this regard, whereas 33 (16%) were defective. Using this information it is possible to assess whether a cast of an impression will produce a die on which a satisfactory restoration can be produced. The breakdown of the figures for each laboratory is shown in Table 3. The 4 cases from Laboratory B that did not specify NHS or private contract have been omitted from the table.

Any case with defects at the margin causing the technician to “guess” at finishing lines was categorised as “unsatisfactory”. In total, 91 (44.2%) of the 206 cases fell into this category. In all cases the margins of the preparations were too indefinite to produce satisfactory restorations. Of these 17 also had blows or drags within the impression of the prepared teeth but not related to preparation finishing lines. Figure 2 shows the assessed quality of the impressions depending on whether the work was being done under private or NHS contract.

DISCUSSION

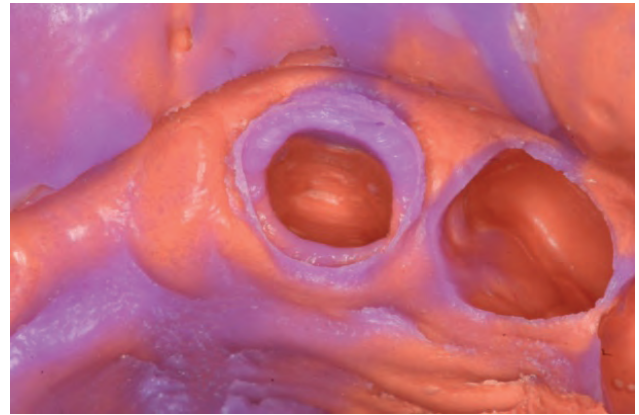
The British Society of Restorative Dentistry have published “Guidelines for Crown and Bridge” with the aim of setting “attainable targets for quality in crown and bridge”¹³. These guidelines cover all clinical aspects in the provision of crown and bridge restorations and form a standard against which clinical work can be audited. The results of this study demonstrate that almost half (44.2%) of all impressions examined were unacceptable when held up for comparison against these standards.

Impression Techniques

Putty-Wash Techniques

By far the most popular material for the working impression was silicone, which was used for 198 of the 206 working impressions. The most commonly employed impression techniques were one- and two-stage stage putty-wash technique. These techniques were evolved to avoid the need for a custom tray¹⁴.

The one-stage putty-wash technique was used on 163 occasions (including 18 dual-arch impressions). The use of two markedly different viscosities at the same time may affect the ability of the impression to record fine detail. Ideally, low viscosity (wash) material should cover the entire tooth preparation as it is able to record fine detail of 25µm or less¹⁰. However, the wash tends to be pushed off the preparation by the putty resulting in areas of the tooth preparation being



This impression was made using a putty-wash technique and demonstrates good soft tissue management to enable a clear reproduction of the preparation margin in the silicone impression material.

Figure 1a. Example of an impression with clearly defined preparation margins.

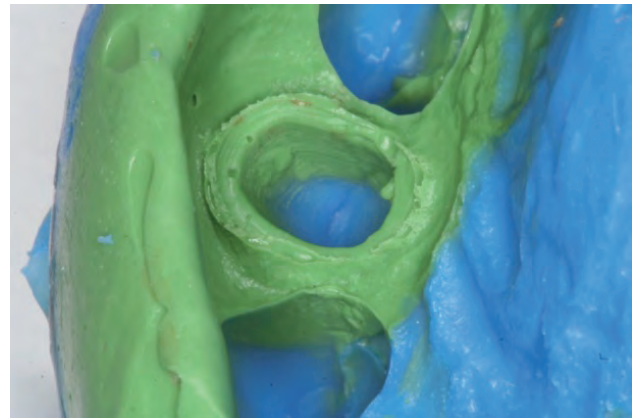
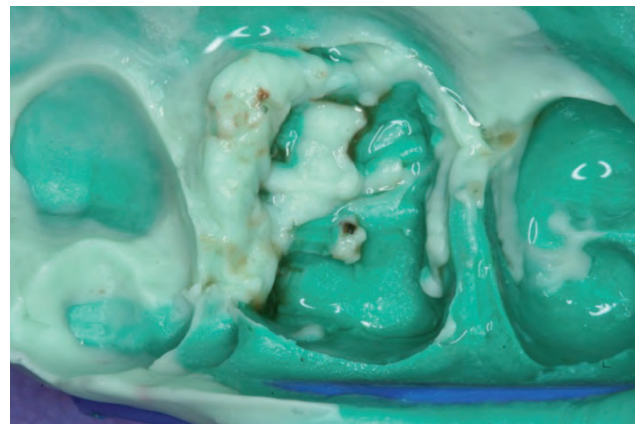


Figure 1b. Example of an impression that would be categorised as probably satisfactory.

The above impression has air-blows on the margins of the preparations so cannot be classed as perfect. However, an experienced technician could probably modify the die cast from this impression and produce a satisfactory restoration from it.

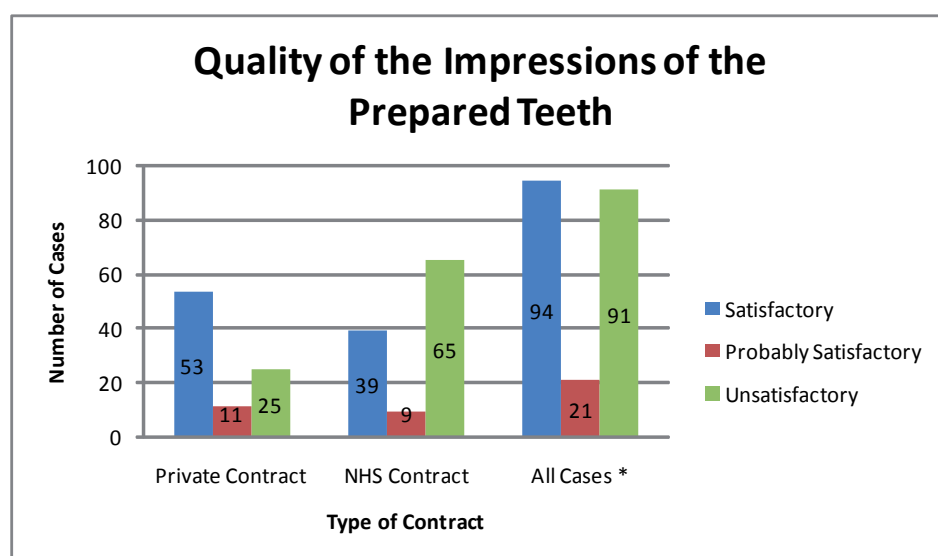


The above impression accompanied a request for an NHS gold crown. It is clearly contaminated with what is likely to be blood and gives the technician no guidance at all as to the finishing lines of the preparation.

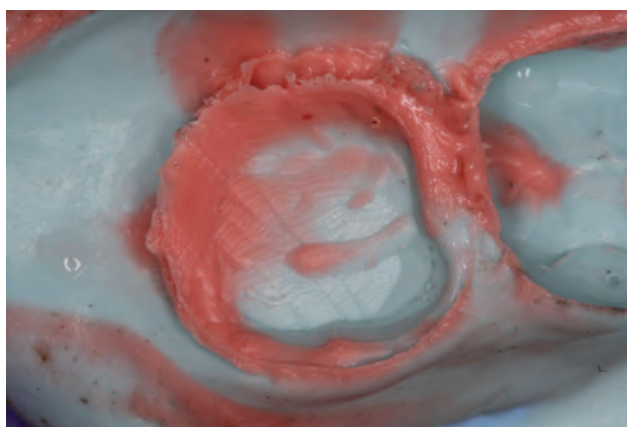
Figure 1c. Example of an impression that would be categorised as unsatisfactory.

Table 3. *Quality of the impression of the prepared teeth at each laboratory.*

	Laboratory A		Laboratory B		Laboratory C	
	Private Contract <i>n</i> (%)	NHS Contract <i>n</i> (%)	Private Contract <i>n</i> (%)	NHS Contract <i>n</i> (%)	Private Contract <i>n</i> (%)	NHS Contract <i>n</i> (%)
Impression Definitely Satisfactory	19 (47.5%)	0 (0%)	27 (71.1%)	10 (38.5%)	7 (63.6%)	29 (33.3%)
Impression Probably Satisfactory	7 (17.5%)	0 (0%)	4 (10.5%)	5 (19.2%)	0 (0%)	4 (4.6%)
Impression Unsatisfactory	14 (35%)	0 (0%)	7 (18.4%)	11 (42.3%)	4 (36.4%)	54 (62.1%)
Total Cases	40 (100%)	0	38 (100%)	26 (100%)	11 (100%)	87 (100%)



(The 4 cases that did not specify contract type are included in the All Cases category)

Figure 2. *Quality of the impressions of prepared teeth (NHS/Private/All Contracts)***Figure 3.**

recorded in putty which is incapable of reproducing fine detail as well as the wash material. All the impressions taken using this technique recorded the surfaces of the prepared teeth in a mixture of putty and wash, sometimes with putty as the sole recording medium at the finishing line.

The second most common impression technique used was a two-stage putty-wash ($n=30$). In this technique a putty only impression is taken first and allowed to set. A spacer may be placed over the putty prior to taking the first stage impression to create space for the subsequent wash (light bodied) impression. Alternatively, no spacer is used and escape channels are cut into the putty impression to allow the wash to escape during the second stage impression. This technique enables the entire preparation to be recorded in light bodied silicone, although a wash thickness of 2mm or less should be aimed for as this has been shown to produce the most accurate stone dies¹⁵.

Dual-Phase Techniques

The use of a custom tray and a dual-phase technique (heavy or medium bodied silicone with a wash material syringed intra-orally) is considered by many as the “gold standard” method, although the technique can be used in a stock tray also. It was seen on 3 occasions in this study, twice using metal stock trays and once using a custom tray.

The Quality of the Impressions Assessed

There was an alarming number of impressions which were either flawed or outright failures and this highlights a definite

need for dentists to critically assess all aspects of their crown and bridge impressions prior to sending them to the laboratory. Comments on the prescription such as “this is the best impression I could take, lingual surface subgingival” in no way excuses the impression seen in Figure 3. Clinically detectable faults in impressions should not be accepted and passed to the technician who then has to use a combination of judgement and guess-work to produce a restoration that will be deficient in some respect. Rather, they should be corrected or retaken so that the technician can actually do their best work.

Figure 4 shows a dual arch impression taken with no tray on which an NHS crown was made. The dentist subsequently reported that the crown did not seat in the mouth and made a new impression which was sent back to the laboratory (Figure 5). Both impressions are equally unsatisfactory and yet the dentist was obviously content with this standard of work. The main point here is that if the restoration had seated it would have been cemented regardless of its undoubtedly poor marginal fit. The quality of the impressions were not unusually poor when compared to others in the investigation. By implication it is likely that many substandard restorations are being fitted which have serious faults from the outset. These will compromise both the longevity of service of the restoration and the health of the teeth on which they are fitted.

Differences in Quality between Private and NHS Impressions

Fewer than half of NHS impressions were assessed as good enough to proceed to making a restoration that may be satisfactory. For the private cases the figure was just less than

three quarters. Interestingly, even within the same laboratory, whether it is laboratory B or C, the ratio of unsatisfactory NHS impressions to unsatisfactory private impressions still remains the same. Although the percentage of NHS impressions graded as “unsatisfactory” was more than twice that as for private impressions, the number of private impression “failures” is in itself unacceptably high even when just considering this parameter.

CONCLUSIONS

Within the limitations of this clinical investigation the number of impressions that were placed into the “failed” category for the criteria examined was unacceptably high for both NHS and private impression cases. However, there were twice as many “failed” impressions under NHS contract than under private contract. However, despite many impressions being assessed as unsatisfactory, many of these cases are likely to have proceeded to have a restoration made and subsequently fitted by the dentist.

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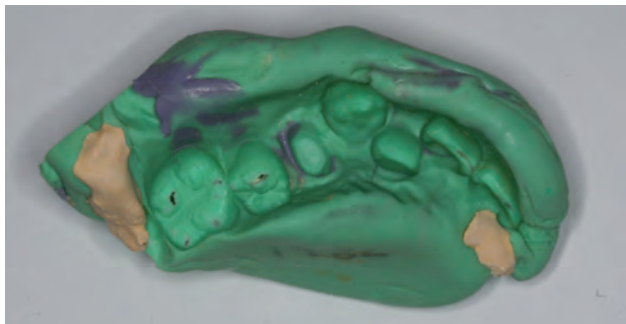


Figure 4.



Figure 5.