THE ANNALS OF DENTISTRY
University of Malaya

ORIGINAL ARTICLE

An Audit of the Turnaround Time of Fixed Prosthodontics Cases in the Ceramic Laboratory

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ABSTRACT

This clinical audit is aimed to provide an insight into the performance of dental technicians in rendering fixed prosthodontics services at Faculty of Dentistry, University of Malaya. A retrospective audit was carried out between 1st of November 2014 and 31st January 2015 using data derived from records and monthly returns of the technicians, which are kept at the ceramic laboratory. Retrospective data on cases of diagnostic wax-ups, full metal crowns, metal ceramic crowns, all ceramic crowns and bridges that were sent to ceramic laboratory for fabrication from 1st of September 2013 to 31st of August 2014 was systematically extracted from the record and tabulated categorically in SPSS version 22.0. The turnaround time in workings day for diagnostic wax-ups and the prostheses was calculated by deducting exit date from entry date. Subsequently, the turnaround time and the complexity of cases were categorized accordingly. The association of turnaround time and the complexity of the cases was analysed using Fisher Exact test with *p* value < 0.05. Within this time frame, a total of 102 cases of diagnostic wax-ups, 36 cases of crown and 18 cases of bridges were fabricated. 57.8% of diagnostic wax-ups were completed within 3 days. 100% of 1 unit crown were completed within 7 days and 94.4% of bridges were completed within 14 days. There was a significant association of turnaround time and the complexity of the cases for diagnostic wax-ups and crowns with p value <0.05. The standard for turnaround time is being met by the ceramic laboratory at Faculty of Dentistry, University of Malaya. However, due to the excessive workload, the overall output of all the measured procedures remains low.

Keywords: Fixed prosthodontics cases, turnaround time.

INTRODUCTION

Clinical audit is a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria. Where indicated, changes are implemented and further monitoring is used to confirm improvement in healthcare delivery (1). Turnaround time is a visible parameter of laboratory services and is often used as a key performance indicator of laboratory performance (2). Thus, it has been recommended as part of a laboratory's quality assurance program (3). The implementation of the quality assurance program is to ensure that health care providers are able to reflect and assess if they have met the goals of service provision. This program also allows for the service providers to obtain feedback on customer satisfaction for the services received.

As part of the continuous quality improvement process, internal audits are conducted to assess and monitor some aspects of laboratory practices that could affect patient satisfaction. Examples include turnaround times, which have become a

great concern to dental practitioners (4). All findings from these investigations should be very carefully reviewed and used to assess whether quality assurance methods in the laboratory are adequate and conform to accepted standards. Unfortunately, reports on turnaround time of dental ceramic laboratories are scarce.

The varied range of work practices amongst different sectors providing oral care make common agreement on turnaround time difficult. However an agreement on standardized turnaround time is vital to ensure an efficient delivery of prostheses to clients without compromising quality.

The fabrication of fixed restoration is generally distributed daily on a rotational basis among the technicians although some experienced technicians may expect more prosthodontic responsibilities rather than administrative duties that may be consigned to the junior technicians. Hence, this gap in workload is possible to provide pliability to the targeted turnaround time. This phenomenon is expected in any dental laboratory setting but compliance to reasonable standard protocols and timeliness are prerequisites to deliver an excellent service to the public.

There is lack of consensus between clinicians and dental technicians on acceptable turnaround time. Previous surveys reported unhappiness by majority of dental technicians claiming insufficient time to construct quality work due to time pressure (5, 6). Unlike clinicians, technicians are in-charge of service quality, which incorporates prohibition of imprecision and inaccuracy, availability, cost, relevance and timeliness (7). This is proven in a cross-sectional survey, whereby clinicians responded in a feedback form implying time to be a more important factor than quality (8). A prolonged turnaround time can compromise the integrity of provisional restoration. Tooth sensitivity and potential pulp damage may eventuate if utilization of provisional restoration is too long (9). This proves that clinicians desire a rapid and efficient service to eliminate risk. Dental technicians on the other hand, have to sacrifice the ideology of preserving the technical or analytical quality of prosthesis for faster turnaround time (3).

Referencing isolated case studies, which have reported on turnaround time as a benchmark, is erroneous due to variation in clinical and laboratory procedures practices. Lacks of information providing clear designation on measuring turnaround time by journals are the major drawbacks when searching for benchmarking.

Since there has been no previous audit carried out pertaining to this topic in Malaysia, a clinical audit on turnaround time of fixed prosthodontics cases in the ceramic laboratory at the Faculty of Dentistry, University of Malaya (UM) has been undertaken. The purpose of this study is to provide an insight into the performance of dental technicians in rendering fixed prosthodontics services in (UM). The data obtained from this clinical audit would help to pave the way for an improvement, if required, in the performance of dental technicians as well as the turnaround rate of the ceramic laboratory in general, which would then reflect on improved service provisions to patients.

MATERIALS AND METHODS

A retrospective audit was carried out between 1st of November 2014 and 31st January 2015 using data derived from records and monthly returns of the technicians, which are kept at the ceramic laboratory, Faculty of Dentistry, (UM). Retrospective data on cases of diagnostic wax-ups, full metal crowns, metal ceramic crowns, all ceramic crowns and bridges that were sent to ceramic laboratory for fabrication from 1st of September 2013 to 31st of August 2014 were systematically extracted from the record and tabulated categorically in SPSS version 22.0.

Retrospective analysis includes the following data:

- Type of cases: diagnostic wax-ups with or without additional laboratory procedures which include special tray and surgical stent fabrication, full metal crowns, metal ceramic crowns, all ceramic crowns and bridges.
- The entry date refers to the date on which the case was sent to the ceramic laboratory.
- The exit date refers to the date on which the case was completed by the technician.

The total number of cases of diagnostic wax-ups and prostheses collected from the records were verified against the monthly returns of the technicians. This was done to confirm that the data collection has been carried out correctly.

To calculate the turnaround time for each case, the following formula was used:

$$\text{Turnaround time} = \text{Exit Date} - \text{Entry Date} \quad (10)$$

However, by consensus, the turnaround time is counted in working days. In order to get the turnaround time in working days, the non-working

days which include Saturdays, Sundays and public holidays were deducted from the turnaround time generated by this equation. Therefore the final equation will be:

Turnaround time in working days = Exit Date – Entry Date – non working days

Subsequently, the turnaround time derived will be categorized as bellow:

As for the cases, it will be categorized as below:

Table 1: Categorization of turnaround time for diagnostic wax-ups and prostheses

Turnaround Time (Working days)		
Diagnostic wax-ups	Full metal crowns, metal ceramic crowns, all ceramic crowns	Bridges
≤3	≤ 7	≤14
4-6	8- 10	15-21
>6	>10	>21

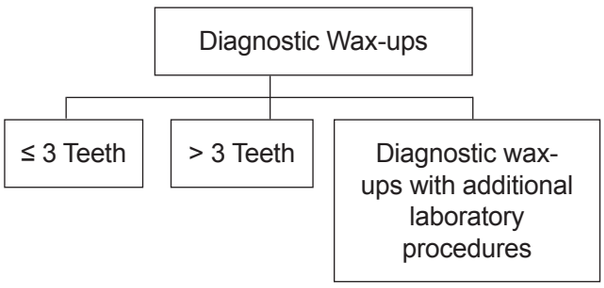

Figure 1: Categorization of diagnostic wax-ups

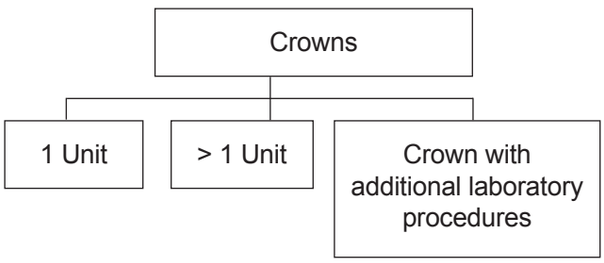

Figure 2: Categorization of crowns

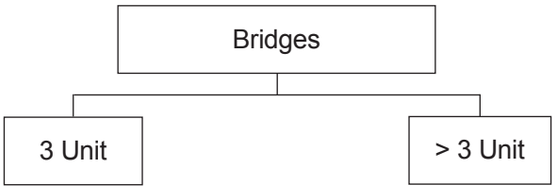

Figure 3: Categorization of bridges

Statistical analysis was done using SPSS version 22.0. The association of turnaround time and the complexity of the cases was analysed using Fisher Exact test with p value < 0.05.

RESULTS

Diagnostic wax-ups

A total of 102 cases of diagnostic wax-ups were received from 1st of September 2013 to 31st of August 2014. Out of 102 cases, 37 cases (36.3%) were diagnostic wax-ups of 3 teeth or less, 24 cases (23.5%) were diagnostic wax-ups of more than 3 teeth and 41 cases (40.2%) were diagnostic wax-ups with additional laboratory procedures (Figure 4). 59 cases (57.8%) out of total 102 cases were completed within 3 days, 18 cases (17.6%) were completed within 4 to 6 days and 25 cases (24.5%) took more than 6 days for completion (Table 2).

By using Fisher Exact test, there is a significant association of turnaround time and the complexity of the cases with p value < 0.05 (p=0.00). 33 cases (89.2%) out of 37 cases of diagnostic wax-ups of 3 teeth or less were completed within 3 days. However, only 14 cases (34.1%) out of 41 cases of diagnostic wax-ups with additional laboratory procedures could be completed within 3 days and the majority (41.5%) took more than 6 days for completion (Table 2).

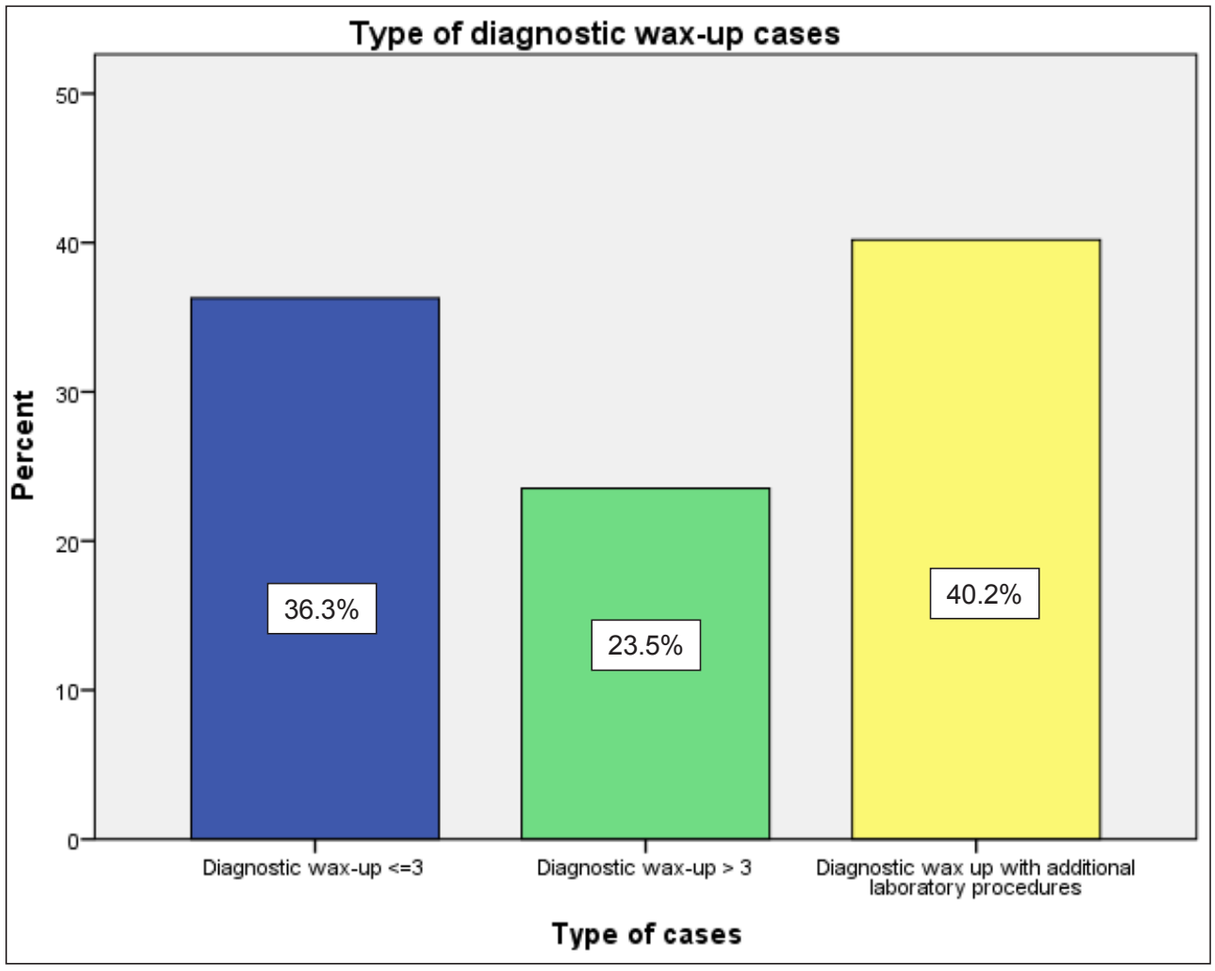

Figure 4: Bar chart of diagnostic wax-ups cases

Table 2: Cross tabulation of complexity of diagnostic wax-ups cases and turnaround time

			Type of cases			Total
			Diagnostic wax-ups <=3 teeth	Diagnostiic wax-ups> 3 teeth	Diagnostic wax-ups with additional laboratory procedures	
Categories of turnaround time	≤3 working days	Count	33	12	14	59
		% within type of cases	89.2%	50.0%	34.1%	57.8%
	4-6 working days	Count	3	5	10	18
		% within type of cases	8.1%	20.8%	24.4%	17.6%
	>6 working days	Count	1	7	17	25
		% within type of cases	2.7%	29.2%	41.5%	24.5%
Total		Count	37	24	41	102
		% within type of cases	100.0%	100.0%	100.0%	100.0%

CROWNS

Crowns fabricated in the lab were divided into 3 categories namely, full metal, metal ceramic and all ceramic crowns. From 1st of September 2013 to 31st of August 2014, a total of 36 crowns were completed which include 2 units of full metal crowns (5.6 %), 24 units of metal ceramic crowns (66.7 %) and 10 units of all ceramic crowns (27.7%) (Figure 5).

By using Fisher exact test SPSS version 22, the results show that there is no significant association between the type of crown and turnaround time (*p*-value >0.05).

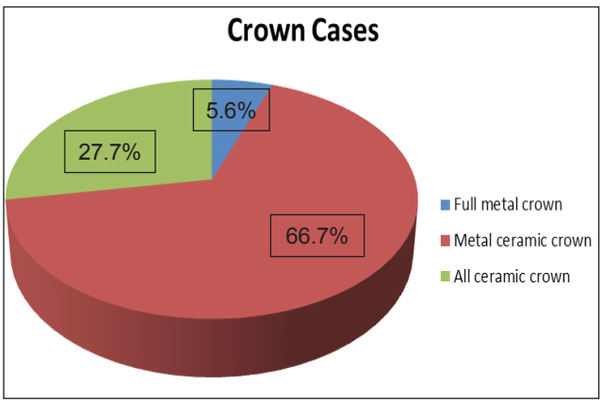

Figure 5: Percentages of each type of crown

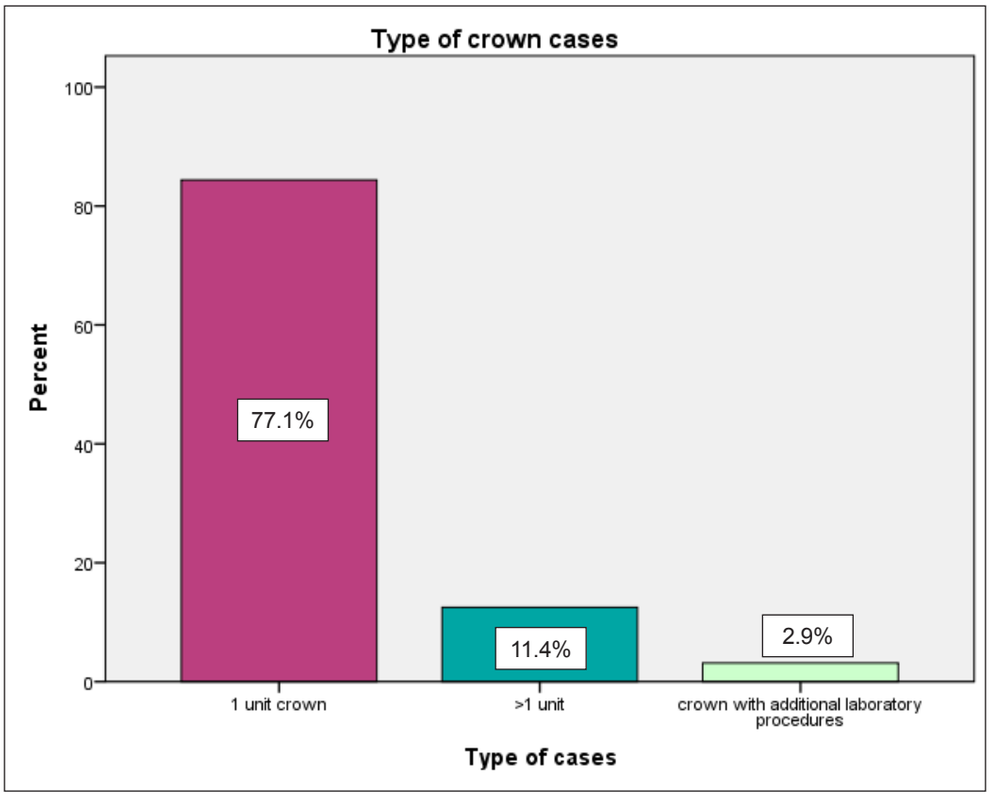

Figure 6: Bar chart of type of crown cases

Out of 32 cases of crowns, 27 cases (77.1%) were for fabrication of 1 unit crown, 4 cases (11.4%) were for fabrication of more than 1 unit crowns and 1 case (2.9%) was of crown fabrication with additional laboratory procedures (Figure 6). 100% of 1 unit crowns (27 out of 27) were completed within 7 working days (Table 3). By using Fisher Exact test SPSS version 22, there is a significant association between the complexity of cases and turnaround time with *p* -value <0.05 (*p*=0.06).

BRIDGES

Within the time frame of this audit, total of 18 cases of bridge had been fabricated. For analysis, they were categorised into 3 unit bridges and > 3 unit bridges (Figure 7). Fisher Exact test SPSS version 22 was used to analyse the data. Out of the 18 cases of bridges, 13 cases (72.2%) were of 3 unit bridges and 5 cases (27.8%) were of >3 unit bridges. 17 out of 18 cases of bridges (94.4%) were completed within 14

Table 3: Cross tabulation of complexity of crown cases and turnaround time

			Type of cases			Total
			1 unit crown	>1 unit crown	Crown & additional laboratory procedures	
Category of turnaround	≤7 working days	Count	27	2	0	29
		% within type of cases	100.0%	50.0%	0.0%	90.6%
	8-10 working days	Count	0	1	0	1
		% within type of cases	0.0%	25.0%	0.0%	3.1%
	>10 working days	Count	0	1	1	2
		% within type of cases	0.0%	25.0%	100.0%	6.3%
Total		Count	27	4	1	32
		% within type of cases	100.0%	100.0%	100.0%	100.0%

working days (Table 4). There is no association between the turnaround time and span of bridges since most of the cases (94.4%) were completed within the agreed time frame which is less than or equal to 14 working days (Table 4).

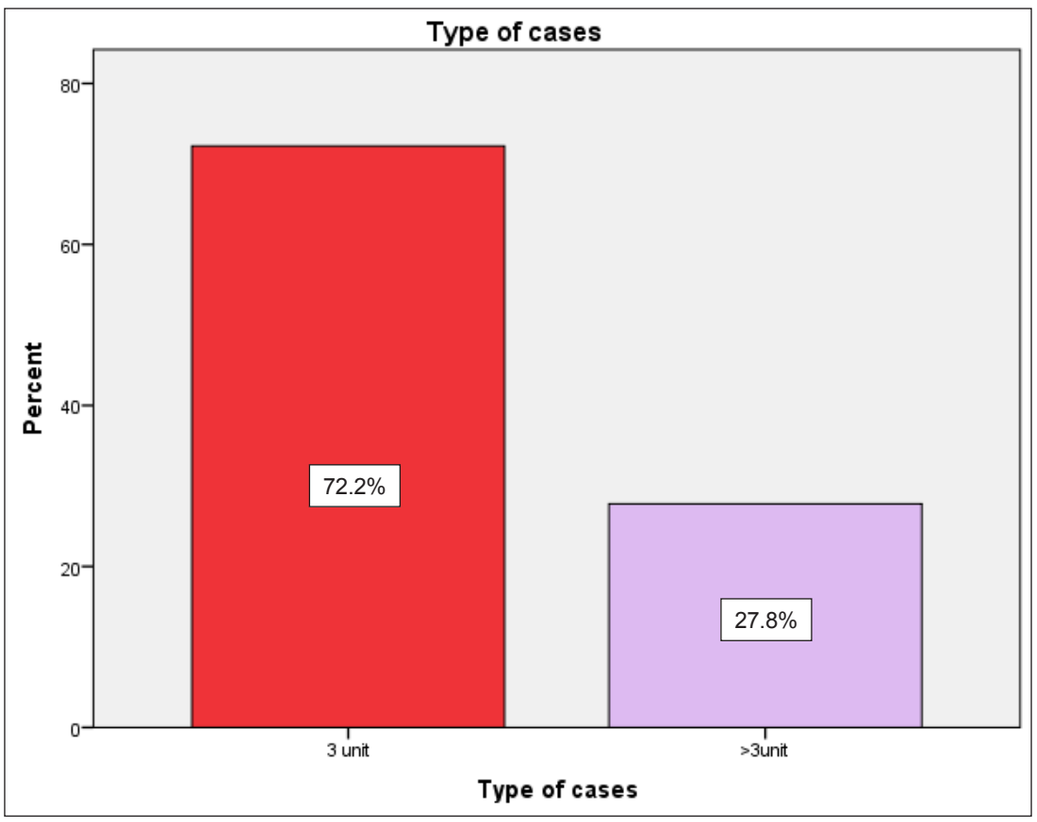

Figure 7: Bar chart of type of bridge cases

Table 4: Cross tabulation of complexity of bridge cases and turnaround time

			Type of bridge cases		Total
			3 unit	>3unit	
Category of turnaround	≤14 working days	Count	12	5	17
		% within type of cases	92.3%	100.0%	94.4%
	14-21 working days	Count	1	0	1
		% within type of cases	7.7%	0.0%	5.6%
Total		Count	13	5	18
		% within type of cases	100.0%	100.0%	100.0%

DISCUSSION

The period from 1st of September 2013 to 31st of August 2014 was selected for this audit because it was the nearest academic year at the time of commencement of audit. Convenient sampling technique was used for data collection, as this was the simplest way to obtain data for the audit.

The turnaround time for this audit was established after personal communication with the laboratory technicians, as no official document could be located detailing the standard turnaround time for the procedures included in the audit even after thorough checking. Therefore, arbitrary categorization of turnaround times was done to establish the extent of any delay from the consensus turnaround time such as categorizing turnaround time for diagnostic wax-ups as less than or equal to 3 days, 4 to 6 days and more than 6 days. Multiple national and international institutes were contacted to acquire the turnaround around times for their ceramic laboratory but no documented standard operating protocol for turnaround times could be obntained.

The entry and exit dates retrieved from the records for the laboratory procedures included in this audit were sorted on per patient basis rather than complexity of the case, therefore the data was further categorized by the authors based on the difficulty of the case. For instance, a case with multiple crown fabrications with additional laboratory procedures was recorded with 1 entry and exit date rather than having completion dates for different components of the case. This complicated the analysis as turnaround around time per prosthesis rather than per patient would have been ideal for this audit.

For diagnostic wax-ups, as apparent from the results, additional time is needed to complete a more complicated case and this is evident from the statistical analysis which infers that there is significant association of turnaround time and the complexity of the cases. The additional laboratory procedures along with the wax-ups included special tray and surgical stent fabrication.

There is no significant association between the types of crowns and turnaround time. However a similar trend of more time required for complicated cases could be seen for crown cases as well. This is also apparent from the statistical analysis which shows a significant association between turnaround time and complexity of the case. In the one case with crown fabrication with addition laboratory procedure, the additional laboratory procedure was bridge fabrication.

Although the cases with bridges were further categorized according to complexity, 17 out of the 18 bridge (94.4%) cases which were included in the audit period were completed within the standard turnaround time and there was no significant association between the span of the bridge and hence the complexity of the case and turnaround time. The one case of a 3-unit bridge took more than 2 weeks because the date of completion as requested by the clinician was after 14 days of date of entry. Hence from the results it is clear that 14 days is ample time for fabrication of bridges regardless of the span of bridge.

From the above stated results it is evident that majority of the cases were completed within the standard turnaround time. However the overall output of the ceramic laboratory was substantially low. Only 102 cases of diagnostic wax-ups, 36 crowns and 18 bridges were fabricated within a period of 1 year.

This can be explained as most of the diagnostic wax-ups of all the cases attended by the undergraduate and postgraduate students are completed by the students themselves with only a few being sent to the ceramic laboratory. As far as crowns and bridges are concerned, majority of the cases are sent to private dental laboratories. Also the technicians in the ceramic laboratory are not only involved with fabrication of diagnostic wax-ups, crowns and bridges but also fabrication of special trays, cast posts and cores, veneers, inlays,

onlays, implant based fixed restorations and resin blocks for endodontic exercises along with teaching undergraduate and postgraduate students. As there are only 3 technicians for all the above-mentioned services, which were not included in this audit report, the overall number of crowns and bridges fabricated in 1 year is considerably low.

Additionally, the ceramic laboratory also caters to fixed prosthesis for implant cases from department of Restorative Dentistry and department of Oro-maxillofacial SAurgical and Medical Sciences, which adds to the workload of the technicians. As there are only 3 technicians dividing the above-mentioned workload, the overall output for crown and bridges is therefore not high.

CONCLUSION

The standard for turnaround time is being met by the ceramic laboratory at Faculty of Dentistry, University of Malaya. However, due to the excessive workload, the overall output of the all the measured procedures remains low.

RECOMMENDATIONS

- An official standard operating procedure for turnaround time including for complex cases should be established as there is no official document detailing standard turnaround times for the various procedures carried out in the ceramic laboratory.
- A new record form has been designed by the authors to incorporate date of entry and exit on per prosthesis rather than the current practice of per patient basis.
- The new record form will have additional columns to include date requested by the clinician for completion of prosthesis and the department from which the prosthesis has been requested.
- Audit of turnaround times of ceramic laboratories in other dental teaching institutes in Malaysia should be conducted so that comparison can be made with regard to output efficiency of the laboratories.
- Re-audit 1 year after the implementations of the recommendations to deduce whether a more detailed and categorized standard operating procedure is being followed and any improvements have been made in the overall output of the laboratory.

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