

## Knowledge Evaluation of Routine Fixed Prosthodontic Procedures used in Construction of Fixed Dental Prostheses among Dental Laboratories in Aljabal Alakhdar Region, Libya.

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### **ABSTRACT:**

**Background:** The use of suitable laboratory techniques and dental materials that are necessary during the manufacturing of that prosthesis will determine if fixed dental prostheses (FDPs) are successful when supplied to patients. Inadequate fabrication process may have an impact on the longevity in addition to the fit or aesthetic effects. To ensure high-quality work, dental laboratories should routinely review each other's understanding of dental materials and fundamental laboratory techniques. With the aid of a validated questionnaire, this survey was carried out to determine the level of knowledge among laboratory technicians regarding the frequently used laboratory techniques and materials for fabrication of FDPs in dental laboratories in the Aljabal Alakhdar region. **Methods:** A survey was conducted with the help of a validated questionnaire that was circulated to 21 laboratories in Aljabal Alakhdar region. The feedback was gathered from laboratory technicians and was then statistically analyzed to achieve the objectives of the study. **Results:** 100 % of laboratories confirmed that technicians working for them were registered under the ministry of health. 95.2% agreed that they only used dental materials that were American Dental Association (ADA) specified. The most common gypsum product for pouring of impressions was dental stone. 100% of the technicians agreed that they inspected the cast before starting the fabrication procedure. Die preparation and ditching procedure was done by 80.9% and 90.5% laboratories respectively. Only 33.3% agreed of using beryllium free alloy ingots, in 100% laboratories, ceramic work was carried out in a separate ceramic room with 100% having adequate ventilation provisions. **Conclusions:** Response of technicians in Aljabal Alakhdar region regarding their knowledge about basic laboratory procedures in FDP fabrication indicates several areas of weakness. Avoiding such inadequacy in laboratories can significantly reduce FDP failure rates.

**Key words:** Fixed dental prosthesis, dental laboratory, survey.

### **INTRODUCTION:**

One of the most difficult areas of dentistry is prosthodontics, which includes both clinical and lab treatments. When prosthetic rehabilitation is recommended for a patient, the patient has a variety of therapy choices to choose from, including fixed and detachable prostheses. The patient's choice of a particular course of therapy is heavily influenced by a number of variables, including age, systemic health, time and financial constraints, and the state of any residual intraoral structures. Patients now voluntarily choose more complex and extensive treatment options than they did in the past as a result of changes in public perception and awareness of dentistry. Due to this, it is now extremely harder for dentists to provide the necessary dental care for patients while still meeting their needs. Regarding comfort. The preference for permanent prostheses over removable ones is always higher when

comfort is taken into account as one of the patient's top requirements. Fixed dental prosthesis (FDPs) are now among the most significant components in the prosthodontics sector. By effectively restoring form, function, and aesthetics, a permanent prosthesis offers remarkable satisfaction to both the patient and the dentist in the treatment of lost teeth. The creation of excellent, long-lasting fixed dental prosthesis is regarded as a testament to the abilities of both the dental technician and the dental practitioner. Success of FDP performed by the dentist directly depends on a number of variables, including clinical care of the patient, case selection, tooth preparation, proper impression production, cementation, and follow-up. Carefully transferring the dental impressions and/or models is another crucial factor. After the dentist has given the dental laboratory the necessary information, the dental laboratory technicians' ability and knowledge play a significant role

in the creation of FDP, which has an impact on the treatment's outcome. For any successful prosthodontic therapy, studies have underlined the importance of good communication and collaboration between dentists and dental laboratory personnel.[1] In addition to communication, the proper use of laboratory techniques during the construction of the prosthesis is essential to the success of an FDP supplied to the patient.[2] If inappropriate or insufficient techniques are used during the construction of any fixed prosthesis, it may not only impact the final aesthetic appearance or fit but also compromise their lifetime. A manufactured prosthesis could be the outcome of a poorly designed FDP. The fabrication of a prosthesis that is physiologically, aesthetically, and functionally acceptable is made possible by the working technicians' proper knowledge of all the fundamental laboratory techniques used in the production of FDP. Therefore, it's critical to evaluate dental laboratory technicians' understanding of fundamental laboratory techniques used in the creation of FDP. With the use of a questionnaire-based survey given to laboratory technicians in the Aljabal Alakhdar region, this study aims to assess the knowledge of fundamental fabrication techniques used by laboratories for the manufacture of FDP.

### **MATERIALS & METHODS:**

A cross sectional survey was conducted to assess the knowledge among dental laboratory technicians regarding the routinely used laboratory procedures for fabrication of FDPs in Aljabal Alakhdar region (Libya) with the help of a questionnaire.

The questionnaire was first piloted for validation on a small number of dental technicians available locally. It was distributed personally to laboratory technicians available locally and the results were analyzed. Accordingly, the validity of the questionnaire was assessed and necessary changes were made in the questions. The final questionnaire consisted of 28 dichotomous questions covering the basic laboratory procedures in fabrication of FDPs. The survey was then distributed to 21 laboratories randomly around Aljabal Alakhdar region. The identity and information of all the laboratory technicians who participated in the survey were kept anonymous. The feedback was then gathered from laboratory technicians and was analyzed to achieve the objectives of the study. Questionnaire was distributed to 30 dental technicians who work in commercial dental laboratories in Aljabal Alakhdar region. A total of 21 usable questionnaires were collected, giving a response rate 70%.

**Fig. 1: Questionnaire for knowledge evaluation of dental laboratory technicians.**

1. Are you registered under the ministry of health ?
  - a) Yes .
  - b) No .
2. Are you only using dental materials that are International standards organization/ American Dental Association (ISO/ADA) SPECIFIED ?
  - a) Yes .
  - b) No .
3. Work received as impression ?
  - a) Yes .
  - b) No .
4. Do you disinfect the received impressions before starting the fabrication procedures?
  - a) Yes .
  - b) No .
5. Do you use vacuum mixing for dental investment materials ?
  - a) Yes .
  - b) No .
6. Do you follow the manufacturer recommended water powder ratio for mixing gypsum products ?
  - a) Yes .
  - b) No .
7. Do you use dental articulator for fabrication of fixed dental prostheses ?
  - a) Yes .
  - b) No .
8. Do you pour base for the working cast ?
  - a) Yes .
  - b) No .
9. Do you allow the poured cast to reach the setting time recommended by manufacturers ?
  - a) Yes .
  - b) No .
10. Do you inspect the working (master) cast before starting with FDP fabrication ?
  - a) Yes .
  - b) No .
11. Do you prepare the die prior to wax pattern fabrication ?
  - a) Yes .
  - b) No .
12. Do you ditch the die prior to wax pattern fabrication ?
  - a) Yes .
  - b) No .

13. Do you mark the finish line on the die prior to wax pattern fabrication ?
  - a) Yes .
  - b) No .
14. Do you use a contrasting coloured pencil to mark the finish line on the die prior to wax pattern fabrication ?
  - a) Yes .
  - b) No .
15. Do you apply die spacer on the die prior to wax pattern fabrication ?
  - a) Yes .
  - b) No .
16. Do you leave 1 mm space from the margin while applying die spacer ?
  - a) Yes .
  - b) No .
17. Do you use different waxes for pattern fabrication ?
  - a) Yes .
  - b) No .
18. Do you follow the recommended liquid to powder ratio of the investment material for investing the wax patterns ?
  - a) Yes .
  - b) No .
19. Do you follow the expansion liquid to water ratio recommended by the manufacturer ?
  - a) Yes .
  - b) No .
20. Do you use beryllium-free dental casting alloys in your practice ?
  - a) Yes .
  - b) No .
21. Do you have any knowledge about berylliosis ?
  - a) Yes .
  - b) No .
22. Adequate ventilation availability ?
  - a) Yes .
  - b) No .
23. Do you have a separate ceramic room in your dental laboratory ?
  - a) Yes .
  - b) No .
24. Do you have a separate ceramic room with proper temperature control ?
  - a) Yes .
  - b) No .
25. Do you re-use the sand in sandblasting machine ?
  - a) Yes .
  - b) No .
26. Do you regularly calibrate the ceramic firing unit ?
  - a) Yes .
  - b) No .
27. Do you use inter-occlusal records for cast articulation ?
  - a) Yes .
  - b) No .
28. Use of porcelain occlusion ?
  - a) Yes .
  - b) No .

**Statistical Analysis:**

The Statistical Package for the Social Sciences (SPSS) version 10.0 software was used to tabulate and enter all of the collected responses. The analysis of the data was limited to employing mean values and descriptive percentile statistics.

**RESULTS:**

In this cross-sectional study, a total of 21 completed questionnaires were received from the participants. Out of 21 responses, there were 19 (90.4%) males and 2 (9.6%) females, The major age group of participants was (21-45 years) who work in a private dental laboratory with less than 15 years of experience, as presented in Table 1.

**Table 1: Demographic characteristics of participating dental laboratory technicians (N = 21).**

Demographics	N %	
Gender	Male	19 (90.4%)
	Female	2 (9.6%)
Age	21-45 years .	
Years of experience	Less than 15 years .	

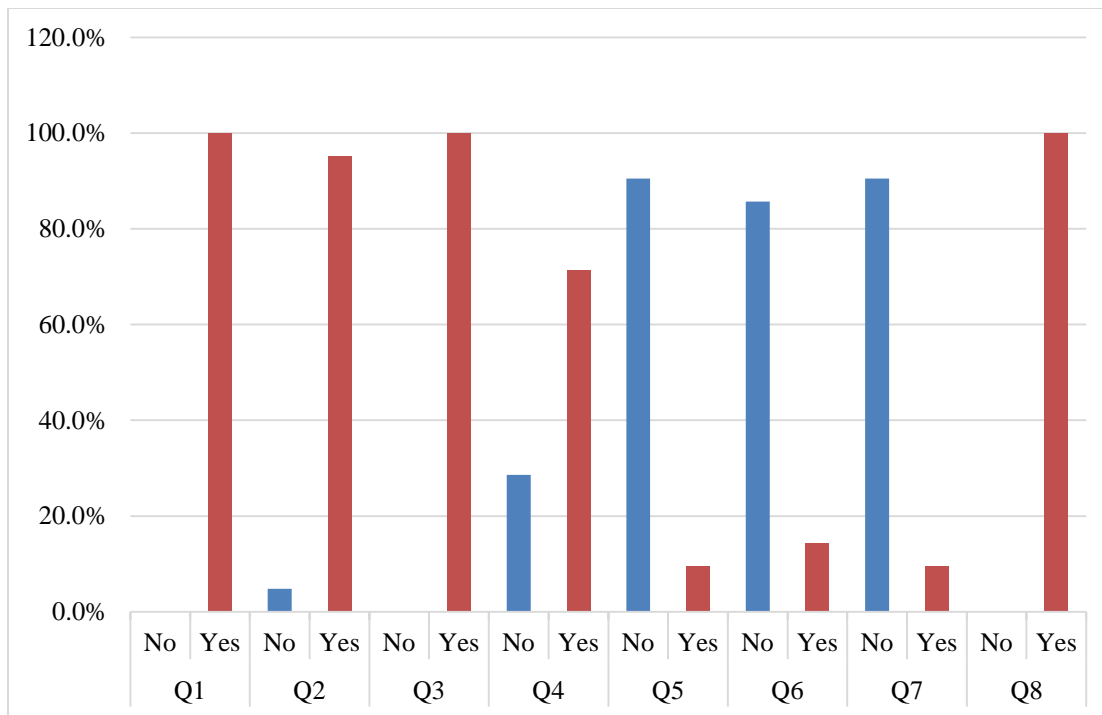
**Table 2: Questionnaire responses for knowledge evaluation of dental laboratory technicians .**

S.n	Variables	Yes N(%)	No N(%)
1	Are you registered under the ministry of health ?	21 (100%)	0 (0%)
2	Are you only using dental materials that are International standards organization/ American Dental Association (ISO/ADA) specified ?	20 (95.2%)	1 (4.8%)
3	Work received as impression ?	17 (80.9%)	4 (19.1%)
4	Do you disinfect the received impressions before starting the fabrication procedures?	15 (71.4%)	6 (28.6%)
5	Do you use vacuum mixing for dental investment materials ?	2 (9.5%)	19 (90.5%)
6	Do you follow the manufacturer recommended water powder ratio for mixing gypsum products ?	3 (14.2)	18 (85.7%)
7	Do you use dental articulator for fabrication of fixed dental prostheses ?	19 (90.5%)	2 (9.5%)
8	Do you pour base for the working cast ?	21 (100%)	0 (0%)
9	Do you allow the poured cast to reach the setting time recommended by manufacturers ?	21 (100%)	0 (0%)
10	Do you inspect the working (master) cast before starting with FDP fabrication ?	21 (100%)	0 (0%)
11	Do you prepare the die prior to wax pattern fabrication ?	17 (80.9%)	4 (19.1%)
12	Do you ditch the die prior to wax pattern fabrication ?	19 (90.5%)	2 (9.5%)
13	Do you mark the finish line on the die prior to wax pattern fabrication ?	21 (100%)	0 (0%)
14	Do you use a contrasting coloured pencil to mark the finish line on the die prior to wax pattern fabrication ?	9 (42.9%)	12 (57.1%)
15	Do you apply die spacer on the die prior to wax pattern fabrication ?	19 (90.5%)	2 (9.5%)
16	Do you leave 1 mm space from the margin while applying die spacer ?	17 (80.9%)	4 (19.1%)
17	Do you use different waxes for pattern fabrication ?	18 (85.7%)	3 (14.3%)
18	Do you follow the recommended liquid to powder ratio of the investment material for investing the wax patterns ?	21 (100%)	0 (0%)
19	Do you follow the expansion liquid to water ratio recommended by the manufacturer ?	14 (66.6%)	7 (33.3%)
20	Do you use beryllium-free dental casting alloys in your practice ?	7 (33.3%)	14

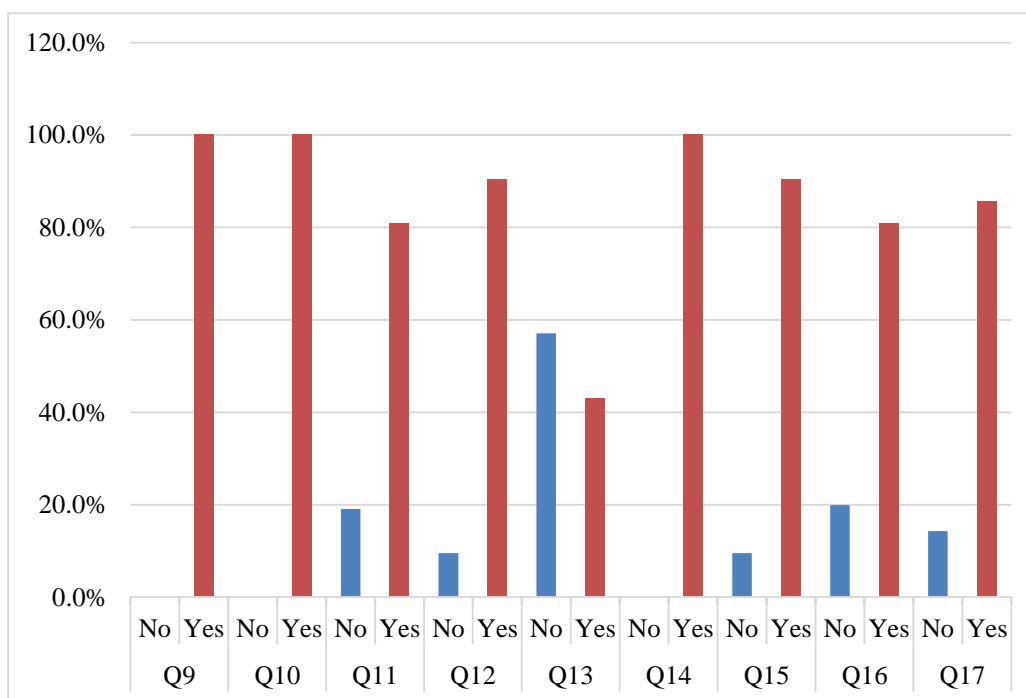
			(66,6%)
21	Do you have any knowledge about berylliosis ?	7 (33.3%)	14 (66,6%)
22	Adequate ventilation availability ?	21 (100%)	0 (0%)
23	Do you have a separate ceramic room in your dental laboratory ?	21 (100%)	0 (0%)
24	Do you have a separate ceramic room with proper temperature control?	21 (100%)	0 (0%)
25	Do you re-use the sand in sandblasting machine ?	10 (47.6%)	11 (52.4%)
26	Do you regularly calibrate the ceramic firing unit ?	13 (61.9%)	8 (38.1%)
27	Do you use inter-occlusal records for cast articulation ?	16 (76.1%)	5 (23.9%)
28	Use of porcelain occlusion ?	21 (100%)	0 (0%)

The response rate was 70 % with 19 out of the 21 laboratories responding to the survey within the stipulated time period. The cumulative results of the survey are presented in Figures 1 to 3. 100 % of laboratories confirmed that technicians working for them were registered under the ministry of health. 95.2% agreed that they only used dental materials that were International Standards Organization / American Dental Association (ISO / ADA) specified. 80.9% of the work received by the labs was in the form of impressions. Disinfection of impressions before starting the procedures was carried by 71.4% of laboratories. The most common gypsum product for pouring of impressions was dental stone (47.6 %), followed by die stone (28.6 %) and dental plaster (less than 15 %). 90.5% of laboratories added gypsum product to water for mixing, with 9.5% of them using vacuum mix. The manufacturer recommended water powder ratio was followed by 14.2% laboratories, whereas 100% followed the manufacturer recommended setting time. 100% of the technicians agreed that they inspected the cast before starting the fabrication procedure. Die preparation and

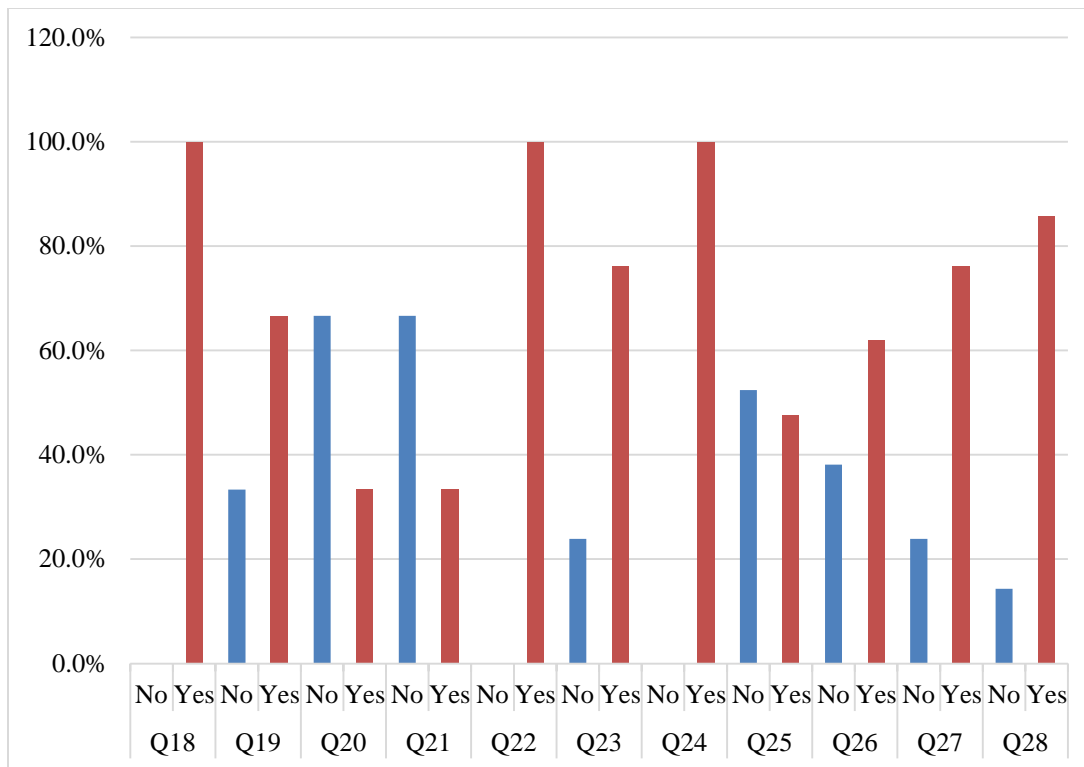
ditching procedure was done by 80.9% and 90.5% laboratories respectively. While 100% laboratories marked the finish line on the die, only 42.8% of them used a contrasting pencil to do the same. 90.5% of technicians used die spacer with 80.9% leaving 1 mm space from the margin. 85.7% used different waxes indicated while carving the wax patterns for FDPs. Considering the investment procedure for wax patterns, 100% followed the recommended liquid to powder ratio of the investment material, while 66.6% followed the expansion liquid to water ratio recommended by the manufacturer. Only 33.3% agreed of using beryllium free alloy ingots and having knowledge regarding berylliosis. In 76.1% laboratories ceramic work was carried out in a separate ceramic room, with 100% having adequate ventilation provisions. 47.6% practiced reuse of the sand in sand blasting unit several times. Regular ceramic firing unit calibration was done by 61.9% of the participants. There is a very high rate of porcelain occlusion (85.7%) requested by dental practitioners.



**Figure 1. Response of Participants Regarding registered Working Technicians, Work Received as Impressions, Whether or Not Steps Such as Impression Disinfection, Cast Articulation, Vacuum Mixing, Water : Powder Ratio, Base Pouring, Setting Time and Cast Inspection were Followed in Dental Laboratories**



**Figure 2. Response of Participants on Whether or Not Steps of Die Preparation, Die Ditching, Finish Line Marking, Use of Contrasting Pencil, Applying Die Spacer, leaving 1 mm Space from Margin while Applying Die Spacer, Used Different Waxes for Pattern Fabrication, Expansion Liquid: Powder Ratio of Investment Material and Expansion Liquid: Water Ratio were Followed**



**Figure 3. Response of Participants on the Use of Beryllium Free Alloys, Knowledge of Berylliosis, Adequate Ventilation Availability, Separate Ceramic Room, Reuse of Sand in Sandblasting, Recommended Temperature Maintenance and Regular Calibration of Ceramic Firing Unit**

**DISCUSSION:**

Patients' attitudes toward and responses to the care they receive in a dental clinic have significantly changed as a result of their increased awareness of and understanding about their own dental health. Patients' interest in fixed prosthesis has changed away from detachable ones as a result of information about the most cutting-edge and pleasant treatment modalities accessible. In order to successfully treat a patient, it is important for the dentist and dental laboratory personnel to uphold their ethical and legal obligations. It is insufficient to rely just on the dentist's expertise and power to assign laboratory tasks based on the patient's functional and esthetic requirements. It is equally crucial that dental laboratory technicians help with prosthesis fabrication. Numerous surveys have been conducted in the past to assess. A number of studies have been conducted in the past to assess how effectively the dentist and lab staff communicate. The findings of these research have significantly improved the two parties' present communication tactics for a higher caliber of work. However, one of the main issues that has not received much attention is the adoption of proper methods in the manufacture of prostheses, particularly for fixed crowns and bridges that demand high levels of fit and precision. Improved communication during the manufacture of

FDPs would be useless if the fabrication methods led to an unsatisfactory prosthesis. This survey study was specifically created to evaluate dental laboratory technicians' knowledge of standard dental laboratory practices used in the creation of FDPs in the Aljabal Alakhdar region.

Cumulative evaluation of the entire survey showed that a mean of 52.2 % followed the correct technique and had adequate knowledge about the same. It was found that only 48.8 % were registered under ministry of health. With only about 25 % laboratories using articulators in fabrication of FDP shows the lack of adherence to proper technique. When fabricating single or multiple-unit FDPs, hand-held casts do not provide sufficient maxillomandibular connection, which may result in an unsatisfactory occlusion or pain for the patient after final cementation.<sup>8</sup> The inter-occlusal record is a crucial diagnostic and treatment method for creating restorations that occlude and function properly by connecting opposing casts on an articulator in a way that mimics the way the maxilla and mandible naturally fit together inside the mouth. The entire laboratory process will integrate an inaccurate inter-occlusal record, resulting in an inaccurate inter-occlusal link between the finished restoration and the opposing arch.

Disinfection is yet another crucial but sometimes skipped process in laboratories.<sup>9</sup> To avoid cross-infections between the patient, dentist, and lab staff, strict disinfection procedures must be followed.

According to the report, 71.4% of laboratories did not follow the recommended disinfection procedure, which increased the risk of infection and cross contamination. In their investigations to assess the effectiveness of dental laboratories to implement disinfection routine for impressions, Kugal G et al.<sup>10</sup> and Hatzikyriakos A et al.<sup>4</sup> found similar results. This indicates that dental technicians' knowledge of and procedures for controlling cross-infection need to be enhanced. The technicians must be conscious, though, that frequent cleaning increases the risk of dimensional stability changes and impairs the capacity to reproduce surface detail. The interaction between dentists and dental technicians is crucial for this.

Dental casts are exact replicas of the surrounding tissue and teeth. The dental material utilized, adhering to the manufacturer's recommended water-powder ratio, mixing technique, setting time, base pouring, and lastly properly examining the cast before beginning the fabrication phase are all variables that contribute to the creation of a high-quality dental cast. The awareness of the aforementioned elements in the current study ranged from 40.5% to 65.9%, with a mean value of 41.7%. It is important that laboratories not only critically evaluate the dental cast that is obtained but also give importance to all the steps from pouring of cast to the final setting period. Failure to do so might lead to fabrication of a fixed prosthesis that may adequately fit on the cast but not intraorally when trying it in the patient's mouth.

Another critical stage in the manufacture of FDP is die preparation. The focus of the current poll was solely on whether laboratories were used for die preparation. The question received about 50% of a good response. Similar to this, fewer than half of the laboratories applied die spacers 0.5 to 1mm above the finish line, ditched the die, and marked the finish line in a contrasting color. An adequate fit and little adaptability are necessary for a long-term FPD. If the aforementioned stages are skipped, the quality of the FPD production may suffer. Routine hygiene practices may be hindered and dental cavities and gingival inflammation may be encouraged if the prosthesis is unable to seat over and adapt to the prepared tooth borders.<sup>12</sup> If the aforementioned laboratory procedures weren't properly followed, even the best and most suited case chosen for FDP could eventually fail.

In order to improve castability by reducing the melting temperature and surface tension and strengthening the binding between the porcelain and metal, beryllium is added to several base metal alloys used for frameworks

of permanent partial dentures and crowns. Contact dermatitis and the chronic granulomatous lung disease (CBD) known as beryllium disease are linked to exposure to beryllium vapor or particles. Melting, grinding, polishing, and finishing processes might result in hazards or dangers from exposure to beryllium. Without a suitable exhaust and filter system, the risk is highest during the casting process.

There have been previous reports of respiratory illnesses and berylliosis in lab technicians who fabricate dental prostheses from alloys containing beryllium.<sup>13-15</sup> Since then, the use of beryllium-free alloys in dental practice has been continuously emphasized. According to the current survey, 38.1% of laboratories used beryllium-free alloy in their labs and the same number knew what berylliosis was. This finding demonstrates the lack of knowledge and awareness among dental workers regarding personal health risk factors. A separate ceramic chamber with suitable temperature management and ventilation was another crucial topic mentioned in the poll. Ceramic materials are typically thought of as inert, but while handling, manipulating, correcting, and finishing the restorations, dust particles from these materials provide a possible issue for the laboratory and clinical staff. Silicosis is brought on by breathing in dust that contains free silica or silicon dioxide particles in ceramic laboratories.

Additionally, find out if the labs frequently calibrated the ceramic burning unit and reused the sand in the sandblasting unit. These inquiries all had comparable patterns of responses. The results of this survey's overall analysis indicate that almost half of the participating laboratories did not adhere to the standard operating procedures and stages needed to fabricate FDP. This is one of the main reasons why the failure rate of fixed dental prostheses has increased over a short period of time. Future FDP failure rates would be greatly decreased by working with more caution.

## CONCLUSIONS

Within the constraints of this survey study, it may be concluded that the lab personnel lack enough knowledge of the fundamental laboratory techniques employed in the manufacturing of FDPS. To raise the standard of the work produced by dental laboratories, emphasis should be placed on the use of proper techniques for fabricating FDPs. Examining the answers provided by the dental laboratory technicians in the Aljabal Alakhdar region to a survey on their understanding of fundamental laboratory techniques for FDP manufacture reveals their areas of weakness. FDP failure rates can be greatly decreased in laboratories by avoiding such inadequacies. Additionally, providing dental laboratory technicians with workshops and continuing education courses can help them learn more, as well as familiarize them with



modern methods and developments in dental laboratory practices.

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