

A Comparative study of some elements of stability of fixed Prosthodontics in the preparation of dental students between two major universities in Syria

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ABSTRACT

This study aimed to compare three preparation stability factors: the degree of inclination of the axial walls, the geometric shape of the occlusal surfaces, and the shape of the cervical borderlines among dental students studying at the Faculty of Dentistry, University of Aleppo and Damascus University. A sample size of 150 clinical cases in the Department of Fixed Prosthodontics-University of Aleppo and another 150 clinical cases in the Department of Fixed Prosthodontics at Damascus University were prepared to receive fixed prosthodontic treatment and accomplished by final-year undergraduate students. The following three outcomes were determined: (1) the degree of inclination of the axial walls, (2) the shape of the cervical borderline being simple, shoulder, and semi-shoulder finish, and (3) the geometric shape of the occlusal surface being flat, little featured, and well-defined. For measuring the inclination of the axial walls, study casts after preparation of the involved teeth were marked. Then all measurements were copied on a millimetric paper to evaluate the degree of inclination with calipers. The results of this study were within the clinically acceptable standards, noting that the proportion of commitment to academic instructions was bigger at the University of Aleppo than at Damascus University. Within the limits of our study, it was found that a good proportion of students from the two universities of Damascus and Aleppo have adhered to the academic instructions given while preparing teeth.



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1. INTRODUCTION

Previous studies about crowns and bridges stability have revealed important recommendations about the degree of inclination of the axial walls of the dental abutments prepared to receive fixed prosthodontics, which must be respected for its impact on the stability and success of the prosthodontic treatment [1], [3], [5], [9].

Stability is one of the most important factors that affect the success of fixed prosthodontics, it is a set of physical factors that prevent Prosthodontics (crowns or bridges) from being plucked out of their abutment

(the prepared tooth) towards the longitudinal axis of the preparation, despite all the forces that work to separate it [5]. And it is affected by the height of the prepared tooth, surface capacity, inclination of the preparation walls, and the cervical-borderline shape [3].

Before any removal of tooth tissue in the preparation to receive fixed Prosthodontics, the entry line must be determined, especially if it comes to preparing a bridge to compensate for a tooth or several missing teeth [5]. It is well documented that the absolute parallelism of the walls increases the stabilizing ability of the prepared tooth [3], [9], but a thick layer of cement will form at the cervical edges and in the occlusal aspect, and the restoration will not fit well on its abutment because the excess cement cannot flow out during the final stage of fixation [1].

Previous studies have mentioned several values for inclination degree of the axial walls, 10 degrees for the front teeth, (14-16) degrees for premolars, and (17-24) degrees for molars [10], [8]. [13] mentioned that any increase in the inclination of the walls more than 24 degrees would decrease the stability of the crowns.

Respecting the anatomical shape of the occlusal surface during the preparation of the front teeth, forming the cusps and flutters is useful in preventing the waste in the consumption of dental tissues, and preserving the vitality of the pulp, and helps the occlusal forces applied to the cusp slopes to be directed to the longitudinal axis of the tooth [13].

On the other hand, the shape of the cervical borders is an important and influential factor in stability. Denissen mentioned five acceptable designs for gingival edges when preparing teeth to receive full crowns: shoulder, chamfered shoulder, semi-shoulder, Semi-chamfered shoulder, and The simple line, and showed that the knife edge cervical borders have more stability than the semi-shoulder cervical borders because dental structures removed during preparation are fewer, while the shoulder shape of the cervical border is less stability than in the previous two cases [4]. Therefore, this shape is only indicated when using full-ceramic restorations on the front teeth, or on the buccal surface of the posterior preparations for cosmetic-faced crowns, since the thickness of the buccal surface is important in determining the thickness of the porcelain that will be baked over it, and the stability and marginal occlusion will be affected, so there must be limits When testing this design, it is prepared to ensure stability, aesthetics, and circumference [8], [13].

It is necessary to prepare the teeth with a semi-shoulder, even if the teeth are short, and this is due to the great benefits that the semi-shoulder provides in accurately clarifying the cervical borderline for the technician, which means the accuracy of marginal occlusion, and guarantees a sufficient thickness for the metal and avoiding the so-called inverted shoulder and what it causes of gingival infections and calcaneal pockets.

This study aims to compare between three stability factors in the preparation in terms of the degree of inclination of the axial walls, the geometric shape of the buccal surfaces, and the shape of the cervical borders among dental students at the Faculty of Dentistry at the University of Damascus and University of Aleppo.

2. MATERIALS AND METHODS

2.1 Study design and registration

This was a cross-sectional study conducted on patients referred to the Department of Fixed Prosthodontics between January 2019 and March 2020. Ethical Approval was obtained from the Local Ethical Committee of the Faculty of Dentistry University of Aleppo (UDDS-157-09042019/SRC-1563). Included patients were registered at the Department of fixed Prosthodontics at University of Aleppo and Damascus university, Dental

School and been examined between January 2019 and March 2020. Informed consent was signed from patients before trial initiation. It was funded by University of Aleppo, Postgraduate Research Budget (Ref no: 55743967221DEN)

2.2 Sample size calculation

The G*Power 3.1.9.2 software (G*Power, Kiel, University of Kiel, Germany) was used to calculate the sample size. The significance level was 0.05, and a statistical power of 95%. The intended test was the independent samples T-test. The mean value and standard deviation value of the stability were taken from a similar previous study [2]. Therefore, the sample size was calculated and revealed the need for 150 patients in each group.

2.3 Patients' recruitment and eligibility criteria

A number of 350 patients who attended the Department of Fixed Prosthodontics at the University of Damascus and Aleppo University were examined and 310 of them were deemed suitable for inclusion. Candidate patients have been informed about the study aims, design and methods. Three-hundred patients (179 males and 121 females) agreed to participate with an average age of 25.3 ± 6.3 .

Patients were given an information sheets, and an Informed consent forms were signed and collected before the commencement of the research project. The inclusion criteria were: (1) extremely deep caries; (2) extensively damaged teeth; (3) endodontically treated teeth; (4) dental fluorosis; (5) cosmetic purposes. Patients were excluded if they had: (1) periodontal diseases; (2) diabetes; (3) low occlusal vertical dimension; (4) no opposing teeth.

2.4 Outcome measures

Inclination of the axial walls:

The principal researcher (BK) marked the collected study casts after preparation, where two lines were drawn on the buccal and lingual surfaces of the tooth, these lines were horizontally parallel and perpendicular to the longitudinal axis of the tooth. The lines met on the mesial and distal surfaces of the tooth.

Mesiodistal width of the buccal surface of the tooth was measured at the level of the lower line using the caliper, where each head point of the caliper located at the lower line ends. The distance between the head points of the caliper was transferred and redrawn on millimetric paper (Figure 1). The same approach was used to measure the distance between the upper and lower lines on the study cast and to transfer and redraw the upper line on the millimetric paper. Two intersecting lines were drawn at one point that formed the mesial and lateral preparation angle for the studied tooth, and it was measured by the geometric protractor (Figure 2). The same method was performed for the lingual surface of the studied tooth, then the average of the two values for the buccal and lingual surfaces were taken.

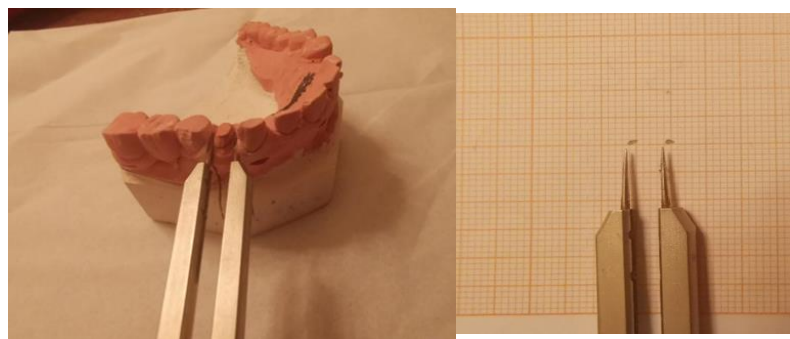


Figure 1: Transfer of the tilt measurement to the millimeter paper.

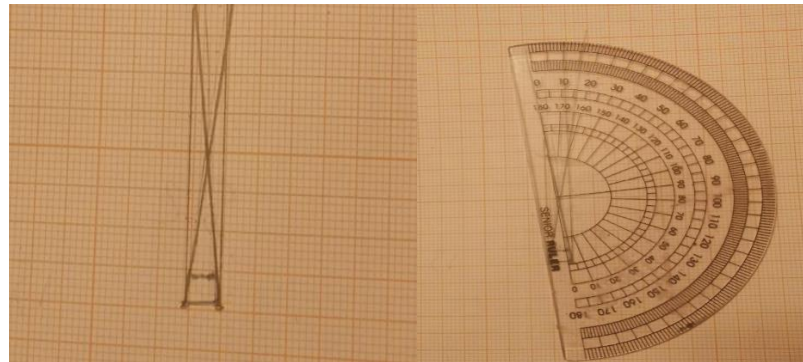


Figure 2: Measurement of the angle of preparation

Cervical borderline used in the preparation

The shape of the cervical borderline was defined before tooth preparation, according to the clinical case, and was performed by final-year undergraduate students.

Degree of clarity of the surface features:

The degree of clarity of the surface features was performed by final-year undergraduate students and checked on study casts.

2.5 Statistical analysis

The SPSS program (version 22.00; IBM Corporation, Chicago, IL, USA) was used to analyze data. Normality of the distributions were investigated using the Shapiro-Wilk tests.

Independent-sample t-test was used to detect the significant differences in the inclination of the axial walls between the two study groups, whereas Chi-square test was used to detect any significant differences in the distributions of the three types of the cervical borderline and in the degrees of clarity of the geometric shape of the occlusal surface between the two groups. The level of significance was set at 5%.

3. RESULTS

Three hundred patients (179 males and 121 females) aged between 18 to 33 years old participated in this study. The Aleppo University group included 150 patients (87 males and 63 females; average age: 24.2 ± 6.03 years), whereas the Damascus University group included 150 patients (91 males and 59 females; average age: 26.4±6.57).

3.1 Inclination of the axial walls:

The mean of inclination of the axial walls values in Aleppo University was 8.70° and in Damascus University was 11.24°, and the difference between means was 2.54° and was statistically significant (p<0.001); (Table 1).

Table 1: Independent samples t-test to study the difference in inclination of the axial walls between the two study groups

| Damascus University | | University of Aleppo | | | | t value | P value* | Difference in means | 95%confidence interval | |
|---------------------|----|----------------------|------|------|----|---------|----------|---------------------|------------------------|------|
| mean | SD | Mini | Max. | mean | SD | | | | Mini | Max. |
| | | . | | . | | | | | | |

| | | | | | | | | | | | | | |
|----------------------------|-------|------|------|-------|------|------|------|-------|--------|---------|-------|-------|-------|
| inclination of axial walls | 11.24 | 2.81 | 6.00 | 17.38 | 8.70 | 1.91 | 5.25 | 13.47 | -8.929 | P<0.001 | -2.54 | -1.90 | -3.00 |
|----------------------------|-------|------|------|-------|------|------|------|-------|--------|---------|-------|-------|-------|

* Independent-sample T-test was used to detect the significant differences between inclination of the axial walls between the two study groups

3.2 Cervical borderline used in the preparation:

At the University of Aleppo, semi-shoulder finish line was used in 90.7% of the prepared teeth, while the simple finish line was used in 6.7% and the shoulder finish line was used in 2.7% of the total count, whereas the values differed in Damascus University where the semi-shoulder finish line was used in 71.3% of the prepared teeth, while the simple finish line was used in 18.7% and the shoulder finish line was used in 10% of the total count, and all these differences were statistically significant ($p < 0.001$);(Table 2).

Table (2) Frequencies and percentages of the types of cervical borderlines used in the two study groups

| Finish line | Aleppo | | Damascus | | P-value* |
|-------------|-----------|-------|-----------|-------|----------|
| | Frequency | % | Frequency | % | |
| Chamfer | 136 | 90.7% | 107 | 71.3% | P<0.001 |
| Knife edge | 10 | 6.7% | 28 | 18.7% | |
| Shoulder | 4 | 2.7% | 15 | 10% | |

* Chi-square test was used to detect any significant differences in the distributions of the three types of cervical borderline

3.3 Degree of clarity of the surface features:

At the University of Aleppo, the scanned without features geometric shape of the occlusal surface was used in 4.7% of the prepared teeth, while the little featured was used in 13.4% and the well-defined was used in 81.9% of the total count, whereas the values differed in Damascus University where the scanned without features geometric shape of the occlusal surface was used in 6.7% of the prepared teeth, while the little featured was used in 27.3% and the well-defined was used in 66.0% of the total count, and all these differences were statistically significant ($p < 0.001$);(Table 3).

Table 3: Frequencies and percentages of degrees of clarity of the geometric shape of the occlusal surface in the two study groups

| Geometric shape of occlusal surface | Aleppo | | Damascus | | P-value* |
|-------------------------------------|-----------|-------|-----------|-------|----------|
| | Frequency | % | Frequency | % | |
| without features | 7 | 4.7% | 10 | 6.7% | P<.003 |
| low clarity | 20 | 13.4% | 41 | 27.3% | |
| clearly defined | 122 | 81.9% | 99 | 66.0% | |

* Chi-square test was used to detect any significant differences in in the degrees of clarity of the geometric shape of the occlusal surface

4. Discussion

The stability value is affected by the presence of multiple variables when preparing the teeth to receive fixed prostheses, such as the degree of inclination of the axial walls, the geometric shape of the grinding surface, and the shape of the cervical borders when preparing the finish line. With a semi-shoulder finishing line, 90.7%, which is a high percentage compared to the other two types of cervical preparations in the shoulder, which amounted to 2.7%, while the preparation with a simple finishing line reached 6.7%, and when studying the results of these variables statistically when preparing students of Damascus University to receive fixed

compensation, it was found that the percentage reached Cervical preparations with a semi-shoulder finish line 71.3%, which is a high percentage compared to the other two types of cervical preparations in the form of a shoulder, reaching 10%, while preparing with a simple finishing line reached 18.7%,

This indicates the students' and their teachers' confidence in the semi-shoulder finish line, which achieves a greater percentage of stability for the compensations. The stability of the final compensation on the semi-shoulder finish line increases its stability because it reduces the point angles tangent between the compensation and the prepared tooth and allows the gluing cement to flow easily between the two previous surfaces and not to aggregate and agglomerate in The preparation angles in the event that the finish line is a shoulder type, and it also secures an engineering base on which the final compensation is based, achieving the continuity between the surfaces of the compensation and the tooth, thus reducing the marginal leakage to its minimum limits, in contrast to the simple cervical preparations

This statistical result is consistent with the results of How, who confirmed that the cervical border that is in the form of a shoulder blade achieves greater stability for fixed compensations [7].

While they differed with both [12], who confirmed that the cervical borders, which are in the form of a knife edge with simple preparation, have more stability.

The percentage of preparations for the shape of the grinding surface among the students of Aleppo University was 4.7%, with scanned features, 13.4% for the preparations with clear features, and 81.9% for the preparations for the shape of the grinding surface among the students of Damascus University was 6.7% with clear marks, and 27.3% for the preparations for the grinding surface with clear marks. The preparations are clearly defined 66%, and this indicates the commitment of the students and the supervising staff to preserve the anatomical features of the prepared occlusal surfaces, which increases the area of actual contacts between the internal surfaces of the fixed compensations and the prepared teeth and thus increases their stability, especially by preserving the shape of the humps and their occlusal slopes and the central gutters that form The main fulcrum of fixed compensation is in its center.

This statistical result is in agreement with [6], [5] who confirmed that maintaining the anatomical shape of the grinding surface achieves greater stability for fixed compensation.

While they differed with both [12], who confirmed that the cervical borders, which are in the form of a knife edge with simple preparation, have more stability.

The degree of inclination of the axial walls of the teeth prepared at the University of Aleppo ranged between 5.2°-13.4° with a mean of 8.7°, while the degree of inclination of the axial walls of the teeth prepared at the University of Damascus ranged between 6°-17.3° with an arithmetic average of 11.2°, and this indicates no waste During the preparation of dental surfaces clinically, as international protocols advise not to exceed 20 degrees for the degree of inclination of the axial walls during preparation for receiving fixed prostheses. 20 degrees Celsius, it negatively affects the stability of the compensation and increases its movement and instability on the prepared tooth. Therefore, the durability of the compensation in this case will require reliance on the final adhesive materials in terms of quantity and type, and this is in contradiction with the principles of successful compensation fixed.

This statistical result is consistent with the results of Smith, who confirmed that maintaining an acceptable degree of inclination of the axial walls achieves greater stability for fixed compensation [11].

While she differed with Omar Zidan, who increased the percentage of inclination of the axial walls and considered the 24 degree to be ideal for the stability of the crowns [13].

5. Conclusion

From the results that we obtained during the clinical study, we conclude that:

- Within the limits of our study, it was found that there is a good percentage of students from the universities of Damascus and Aleppo, who adhered to the academic instructions given during the preparation of the teeth. The University of Aleppo is more than the University of Damascus.
- The largest proportion of students in the two universities has committed to preparing the grinding surface while preserving its anatomical shape, and this preserves the dental tissues and preserves the pulp, and this increases the resistant form of the prepared tooth and increases the contact surface between the compensation and the prepared dental tissues.
- The largest proportion of the students of the two universities adhered to the neck borders in the form of a semi-shoulder, and this leads to an increase in the percentage of stability.
- The average affinity (the degree of inclination of the axial walls) of the abutments prepared by the dental students at the University of Aleppo, was less than it compared to similar studies conducted by the dental students at the University of Damascus, but it did not exceed 20, and this reduces the waste of dental tissues during the preparation.
- We noticed the availability of the triad of principles of preparation, which is the preparation of the grinding surface with clear features, and a semi-shoulder finish line with a degree of inclination of 10-15 degrees, which achieves the largest percentage of stability for the offset, and this is what is being studied academically at the universities of Aleppo and Damascus.

The follow-up of all clinical cases included in this study must be continued for multiple periods of time, in order to know the effect of the degree of inclination of the axial walls of all these cases, which differ in their value, on the stability of fixed compensation, with an emphasis on careful examination of these cases during their follow-up.

We must do a thorough and thorough examination of the abutments on which the crown or bridge will rest, to ensure that the restoration is not torn off, especially in the case of bridges, to ensure that the bridge does not fall off from one of the supports without the other.

6. References

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