Mosul Journal of Nursing

www.mjn.mosuljournals.com

A study on the effect of finishing line depth on the strength of Feldspathic ceramic in dental clinic

Article information

Article history:
Received November 9, 2020
Accepted November 25, 2020
Available online May 5, 2021

DOI: 10.33899/mjn.2021.168078
https://mjn.mosuljournals.com/article_168078.html

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Abstract

CAD/CAM dental restoration had become a sequence of digital tool and software to perform best esthetic with strong material. The effect of only three marginal thickness (0.5,1.0 and 1.5mm) on fracture strength of feldspathic ceramic (FSC) ceramic have been deal within present project Thirty-six (36) die model were tested in separate, fracture load has been carried out until catastrophic failure occurred using low speed video recorder. Range of variation at the values exceed 2000N for all the three sets whereas the mean value of fracture strength for 0.5,1.0,1.5 mm marginal thickness was 1873,2028 and 1296 N respectively. Standard deviation and coefficient of variance were calculated for the result. The influence of these three-finishing line depth on fracture strength of FSC was not so clear. Still applying FSC is promising for prosthodontic restoration as an alternative to the previous metal ceramic. Future studies could lead to more precise answer to the most suitable finishing line.

Keyword :dental clinic , Feldspathic , dental clinic , strength of ceramic

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Introduction

At Present time, it's quite clear that CAD/ CAM dental restoration is going to be become a real sequence of digital tool and software for both the known automatic design and for creating dental restoration (Tapiea et al., 2015). Therefore the job of clinicians, nowadays, had become quite simple and easy to choose CAD/ CAM material in order to perform best esthetic with strong materials (Abdel-Azim et al., 2015). In fact application of different material through CAD/ CAM system for tooth color restoration currently is becoming quite common, for example ceramics such as (Zirconia, esthetic and hybrid ceramics then CAD/ CAM composites, polymers, metal and fiber reinforced resine etc…) (Alghazzawi, 2016; Li et al., 2014). However, it's evident that through application of such materials quite many matters have been fabricated such on single copings, temporaries, crown dentures surgical guides and even complex arch (Porto et al., 2016).

As the demand for more esthetic, healthy life and wholesome persist and increase, the need for such contribution and attempts to biocompatibility restoration materially remain the request of patients and dentists continuously. In fact probably this is why, at present, dental ceramic had become more popular, widely practiced and applied by dentists (Hussain, 2008; Miyazaki et al., 2009).

Actually, fracture resistance of all ceramic's material was and still is the main problem facing the patients with ceramics restoration along with the process of follow up by dentists. (Kern, 2009). However, many scientists had proclaimed that the design of the finishing line of prepend teeth may be an important factor that has a role in marginal adaptation as well as fraction resistance of the crown (Beuer et al., 2008; Ozer et al., 2015). Others on the other hand, believe that adequate marginal and internal fit, as well as selecting a reliable lating cement may be the most important factor in improving the prognosis of the prosthetic restoration (Ahlholm et al., 2018).

The present investigation had carried out in order to evaluate the role and the important of the effect of finishing line depth on the strength of Feld spathic ceramic material made by CAD/ CAM system, since its one of the most widely spread and commonly used material in dental clinics (Sakaguchi & Powers, 2012). The chosen finishing line depth applied in this study were 0.5, 1.00 and 1.5 mm. the outcome results may well lead to find out the best suitable finishing line for this material as well as other materials. The results have been forwarded in the form of tables as well as graphs, illustration of the statistical estimation of the outcome result have been presented and the result were discussed.

Martial and Methods

All the procedures and material applied and used throughout the present investigation have been performed within the scientific laboratory and prosthodontics department of faculty of dentistry/ van uzun-cu yil university, van, Turkey.

The chosen model material for glass-ceramics crown used in the present study was Feld spathic ceramic (CEREC Bloc ceramic for CEREC (sirona) with14 A2c CEREC bloc). Thirty six (36) die models were obtained from nickel chrome material, all were standardized with a height of 6mm and 8mm occlusal diameter. The angle of the entire wall was set up to 96 degree. All sample specimens were tested in separate three groups (n=12 for each) on the bases of the three selected finishing line depth of crown shoulder margin (0.5, 1.0 &1.5mm). The detail of the procedures is found in (magne et al 2015, catellini et al 2015, Elsaka 2014 & khidher 2019).

Fracture load test have been carried out until catastrophic failure occurred using low speed

video recorder in order to determine exact fracture with load magnitude (Khideler 2019). The fracture strength values were statistically analysis using one-way A nova in order to variety significant deference among the three group of the samples, the statistical analysis and level of significance was set up at a=0.05. mean, median, maxim, minim, standard deviation & coefficient values were calculated accordingly.

Results

A total of thirty-six (36) crown of Feld spathic (FSP) ceramic were prepared in three sets, each with twelve specimen of specific finishing line depth as follows (0.5, 1.0, and 1.5 mm). Effect of each of these marginal thickness on fracture strength of every specimen had been calculated and measured in the laboratory, the result were expressed in newton (N). However, all the result have been tabulated in table (1).

Actually, although each specimen gave a specific response meanwhile the result indicates and reflect a wide range of values, in fact table (1) shows that the absolute minimum value of fraction strength for all specimens in all the three group of finishing line depth was only 513 N which was recorded within 1.mm depth sets. Whereas the absolute maximum value found within the group of 0.5 mm depth line set. When the recorded value was 3233 N.

The result indicated that the range of variation among the twelve specimen of each of the three sets had always exceed 2000 N. still the maximum range of variation (2533 N) had been observed with FSC at 1.00 mm depth line where as the minimum value (2006 N) were recorded with a set of 0.5 mm depth line. In fact whenever plotting the fracture strength value against thickness of the nonlinear relation will be evident fig (1) Through present investigation, the pattern of relation was observed when one plot the mean value of fracture strength against the wall thickness. The absolute difference between the three group of field spathic ceramic the mean value of fracture strength was more than 500 N in fact the result indicate the value of 1873, 2028 and 1296 for 0.5, 1 and 1.5 mm finishing line depth of the specimen such relation was also observed when one plot the maximum and minimum values of restoration also fig (1) and table (2) .

Table (1) fracture strength values in Newton (N) of Feld spathic (Fsc.) according to the depth of finishing line in mm.

No. of samples	FSC. 0.5mm/N	FSC. 1.0mm/N	FSC. 1.5mm/N
1	1543.5	1716.0	1297.0
2	1654.0	1779.0	1239.5
3	1501.0	2346.0	2979.5
4	1227.0	1422.0	651.7
5	2337.0	2773.0	847.2
6	3233.0	2977.0	2134.0
7	1868.0	1959.0	1116.0
8	1995.0	513.0	1015.0
9	2090.5	2408.5	903.5
10	1824.5	1730.0	984.0
11	1365.5	1674.0	1261.0
12	1837.5	3046.5	1132.5
Range of variation	2006	2533.5	2327.8
mean	1873.0	2028	1296.3

Table (2) Fracture strength value (Newton) in respect to FSC with different marginal thickness

Finishing line depth of FSC in mm	Mean /N	Minimum/N	Maximum/N
FSC 0.5	1873	1227	3233
FSC 1.0	2028	513	3046
FSC 1.5	1296	651	2979

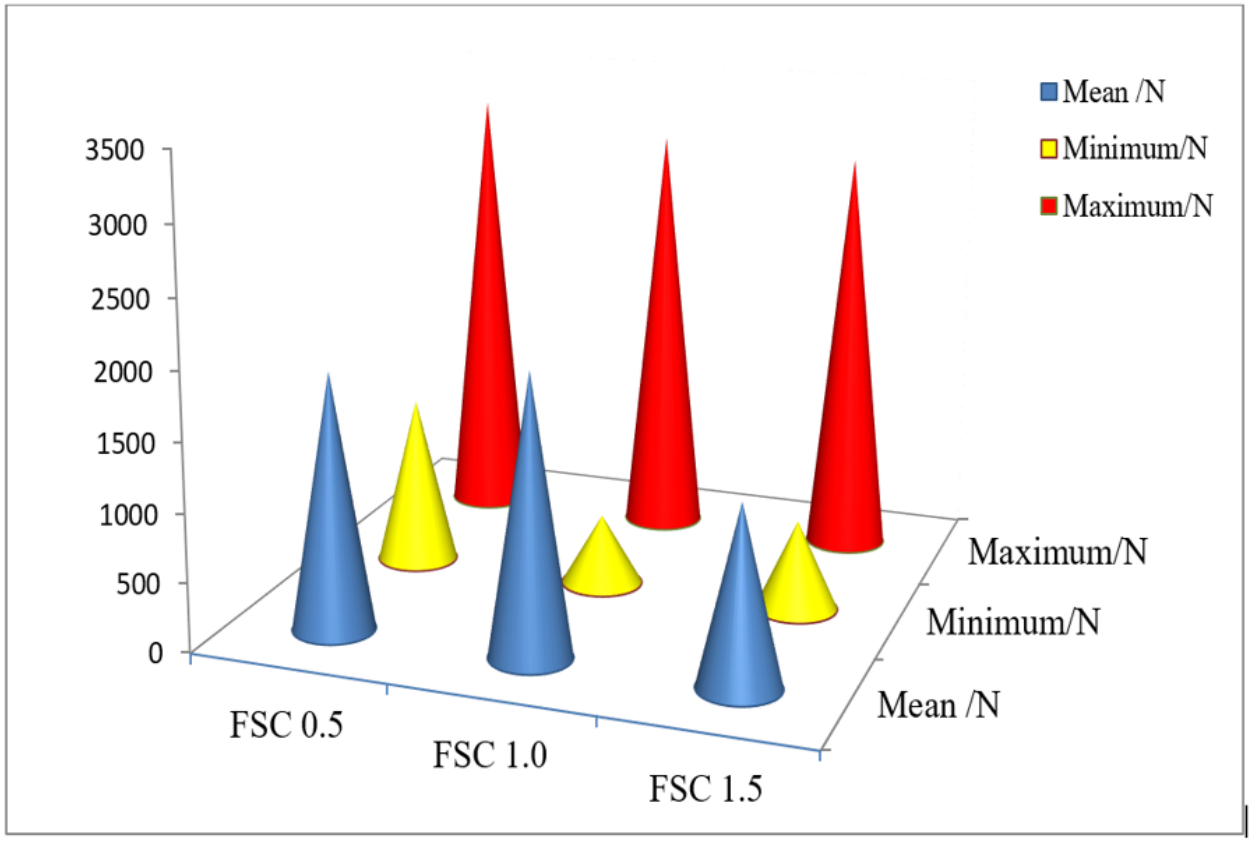

Figure (1) The relation between mean, minimum, and maximum value of FSC restoration with three finish line depth

Table (3) illustrate all statistical calculation and it shows that almost the pattern of variation will be observed even when median value is considered. The result was quite Close for all the three group of experiment. In fact, the range of variation between all groups was only 731.5 & 731.38 for both median and mean values respectively.

Table (2) showed statistical value of all the three-finishing line depth (0.5, 1, 1, 0) of Feld spathic ceramic

Item no.finishing line depth / Item value	1Finishing line depth 0.5mm	2 Finishing line depth 1.mm	3 Finishing line depth 1.5mm	Range
Median	1831.1	1865.73	1124.25	731.5
Mean	1873.04	2028.12	1296.74	731.38
Minimum	1227.0	513.00	651	714.0
Maximum	3233.0	3046.5	2979.5	253.5
Standard deviation	530.9	724.9	642.9	194
Coefficient	0.0028	0.0035	0.0049	0.0021

Table (3) also refer to that maximum value of fracture strength was much close to each other in contrast with minimum value for all the three different marginal thickness used in the present investigation. The standard deviation and coefficient value of all samples was also estimated for all the three sets of experiment Table (2).

Discussion

One of the main goal and targets of clinicians and dentists to be achieved was and still is to improve the quality of the dental restoration as well as to reduce the duration, however the increase consumption of acid drinks, carbonates, fast and sticky food in one hand and the increase of caries teeth on the other hand have become a major dental problem facing the dentists all over the world (Reich & Schierz, 2013). All these points was and still is behind the increasing demands and requests for various sort of restoration.

Actually, various CAD/ CAM ceramic crown do reflect excellent esthetic appearance, in contrast they also go through successfully, for restoring posterior and anterior teeth (SILVA et al., 2017). In fact clinical success of Feld spathic material have been well demonstrated through quite many previous investigation (Otto & Mörmann, 2015; Reich & Schierz, 2013), still fracture possibility of ceramic restoration is the main concern of dentist (Campos et al., 2015).

In fact most previous studies on the fracture strength had repeated that the sequence of the value is generally around 1000N still higher value around 4000N have also been reported (Sagsoz et al., 2016), the effect of three marginal thickness (0.5 mm, 1.0 mm &1.5mm) on fracture strength of Feld spathic CAD/ CAM restoration have been dealed with in present investigation, however the results was quite close to non-pneumatic distribution therefore both mean and median values were considered and applied for statistical analysis (Table 3) its clear that both values for 0.5 mm marginal thickness were found to be quite close (1873 & 1831 respectively). whereas for 1 &1.5 mm depths although the difference approach 15% of the value 2. however, the range of variation of both mean and median value were almost same for all the three-depth line taken in consideration

in this study (table 3). Almost same phenomena was evident with values of maximum and standard deviation whereas when considering the minimum value for 0.5 mm finishing line depth was around double of its value in both 1 and 1.5 mm depth. In contrast, kostue (216) showed that fracture strength will increase with increasing thickness of restoration, further more zimmemann and zaruba (2017) , on the other, hand evaluated the maximum fracture strength load needed in order to fracture of the restoration may be related to the margin thickness of material. However throughout present study the value was more than two-fold higher in case of 0.5 mm finishing line depth in comparison to 1&1.5 mm marginal thickness.

Actually Feld spathic with 1.5 mm depth line reflect the lowest mean fig (1) and median value (Table 3) of fracture strength when contrasted with other two (0.5 & 1.mm) marginal thickness throughout the present investigation. Furthermore the cement thickness may also be regard as an important factor on the duration of restoration and fracture strength who pointed out that fracture strength will decrease when cement thickness increase from 50 to 200mm. As the adhesive bonding technique improved resin cement had been found to seal small cracks and influence the stress at the bonding interface between tooth and restoration (Nejatidanesh et al., 2015). However panaria 5 resin cement were used in the present investigation (Khidher, 2021) which enhance increasing resistance of restoration to fracture.

In fact CAD/ CAM unit still is not cheap enough to be used in prosthodontics dentistry but its expected that such techinque be applied widely, and improve in near feature, so will enhance resistance of restoration, However quite many scientist had referred to such development in the CERE C2 and 3 system over C1 in order to avoid and overcome some associated problem with restoration also rase up milling precision in order to increase marginal fit of CEREC restoration. In contrast in the present study C4 system have been applied as a much more advanced form of CAD/ CAM generation (Khidher, 2021).

The influence of different finishing line depth (0.5, 1 and 1.5 mm) on fracture strength of field spathic material was not evident clearly in accordance to the current investigation, the out come of the results. Still it seems that more suitable finishing line was1.0mm rather than 0.5 and 1.5mm marginal thickness. However, the increasing value of fracture strength was linear from 0.5mm to 1.00mm and decreased at 1.5mm convnsely. Furthermore Feld spathic is still considered as promising prosthodontics restoration as an alternative to the pervious metal ceramic restoration in posterior region in addition to it is esthetical and biochemical properties, its available with quite good mechanical properties that can resist occlusal force in oral cavity. However future study could be modified in order to provide a much more precise and accurate answer to the questions meanwhile the present study undoublty will enhance more detailed work in this field in regard to taking more samples, various and different marginal thickness using other material also could be conducted with extracted human teeth or on Implant once that would be a better simulation of a clinical setting.

Conclusion

1.The maximum mean value of fracture strength of FSC (2028(+-) 724 N) was presented with 1.0mm depth of finishing line. And the absolute minimum mean value was recorded with 1.5 mm depth of shoulder finishing line.

2. fracture strength value increased linearly from 0.5 to 1.0 mm and decreased incase of 1.5 mm

3. FSC found to be promising prosthodontics restoration alternative to the previous metal ceramic, more detail future studies needed to get much more precise and accurate out comes.

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