ISSN: 3067-2422
Research Article
Journal of Complementary Research and Alternative Medicine

Local Fabrication of a Modified Dental Crown Flask and Clamp (Portex Flask) for Dental Technology Practice

Eyarefe OS[1*], Olum PC[1], Anozie CI[1], Ibe E[1], & Okafor NR[2]

[1]*Dept of Dental Technology, Federal University of Technology Owerri*
[2]*Federal University of Allied Health sciences Trans-Ekulu Enugu State*

[*]**Corresponding author:** Eyarefe OS, Dept of Dental Technology, Federal University of Technology Owerri.

Submitted: 16 September 2024 **Accepted:** 23 September 2024 **Published:** 01 October 2024

https://doi.org/10.63620/MKJCRAM.2024.1001

Citation: *Eyarefe, O. S., Olum, P. C., Anozie, C. I., Ibe, E., & Okafor, N. R. (2024). Local fabrication of a modified dental crown flask and clamp (Portex Flask) for dental technology practice.J of Complement Res Altern Med 1(1), 01-07.*

Abstract

Background: *This research aimed to develop a locally fabricated dental crown flask and clamp as an alternative to expensive imported options. The project was conducted at the Centre for Industrial Studies workshop II at the Federal University of Technology, Owerri, between August and October 2018. The goal was to produce a modified dental crown flask and clamp using affordable metallic materials.*

Methods: *A quasi-experimental design was employed to fabricate the flask and clamp using aluminum, mild steel, and copper. The imported flask and clamp served as the control group. Aluminum was used for the clamp base, copper pipes for the two rods, mild steel for the screws, and copper for the top brackets.*

Results: *The study demonstrated the feasibility of fabricating dental instruments using locally sourced metallic materials. The modified flask and clamp were successfully produced within the university community. The fabricated instrument was used to fabricate acrylic jacket crowns, proving its viability for the intended purpose.*

Conclusion and Implications: *The successful local production of the dental crown flask and clamp offers a more affordable and accessible option for dental professionals. This development can contribute to reducing dependence on imported dental equipment and promoting self-sufficiency in the dental technology industry.*

Keywords: Cranberry, Agar well, Gram-Negative Bacteria

Background

In Dental Technology, appliances are constructed to effect treatment of patients. In course of constructing these appliances various materials, tools, instruments and equipment are needed to enhance the Dental Technologist manual dexterity. Among these tools and equipment is the flask and clamp. Flask is used as an aided instrument that enhances appliances construction in Dental Technology laboratory to replace loss tissues and structures while a clamp is mechanical device that is used to hold the flasks firmly together during laboratory work.

Dental laboratory equipment encompasses the full range of system used for fabrication of fixed or removable dental appliances. Dental laboratory equipment like dental crown flask and clamps are highly expensive and their use in dental laboratory are so significant in the normal procedures for the fabrication of appliance (Vijannayin Yakub,OsuOgbere&IdiatOlajumoke 2017).

Hornby AS defines flask as a bottle with a narrow top used in scientific work for mixing or storing chemicals [1]. Also, Microsoft Encarta dictionary defines flask as mould used in foundry: a frame packed full of sand, used in a foundry to make a mould [2]. Clamp is known to be a holding device: a mechanical device with movable jaws used to hold two things firmly together or one object firmly in position [3].

In Dental prosthodontics, we have two types of flask, the Dental flask (also called Denture flask) and the crown flask (also

called portex flask). Dental flask is used for the fabrication of partial dentures and completed dentures; crown flask is used for the fabrication of crowns and bridges with short span like one unit or two units crown while for long span a Denture flask is used. Crown flask is a metallic flask made of alloys, for example brass, stainless steel which is more expensive but a crown flask made of Aluminum will be less expensive, more affordable and lighter in weight.

Dental flask is of great importance because it is used in the following.

- It is used for investing dental models prior to boiling out of the wax pattern.
- It is used for packing and processing of clear acrylic resin.
- It can be used for investing piece of metals to be soldered.
- The damp acts as the substitute or replicate of the bench press to ensure the exact or same pressure that should be maintained in the flask.

The crown flask and clamp are manufactured from raw metallic materials such as aluminums, iron, brass, stainless steel, or combination of metal to improve its strength, hardness working properties and durability.

In Dental Technology practice different attempts have been made by several people to produce crown flask locally but due to lack of enabling technology, futility of the attempts results. It is necessary therefore to find ways of designing and fabricating these flasks using locally sourced materials for the purpose of boosting Dental Technology practice in Nigeria.

This instrument is indispensable in the practice of dental technology (especially in the fabrication of crowns, bridges and inlays) and it's got to our hands through the importation at a relatively high cost. This has made the instruments and equipment's not to be readily available to both undergraduate students (for their practical works) and to practitioners in dental clinics.

Many dental patients do not mind to correct or replace their missing teeth because of the high cost of appliances. The dental technologists are not at fault because the materials and equipment used are much cost even at present; you will hardly get it from the Market.

To overcome all the problems, the dental technologist, both undergraduates and practitioners should endeavor to manufacture the local instruments and equipment like crown flask and clamp to reduce the cost and embarrassment of paying for online instrument which also contribute to the depreciation of Nigeria currency.

Research Questions

- Are these materials for fabrication of crown flask and clamp affordable and available in Nigeria?
- What are the constituents of crown flask and clamp and can they be locally sourced?
- Is instrumentation a critical area to be looked into in Dental Technology
- Is the design and fabrication of crown flask and clamp feasible in our immediate environment?
- Will the product from locally sourced material have similar characteristic with the foreign type and can they withstand dental laboratory procedure?
- Is cost the great concern in the importation of foreign made Dental crown flask.

Materials and Methods

A quasi-experimental approach was adopted during the production of this local crown flask and clamp. This design was adopted because of the fact that the researcher cannot randomly assign subjects into treatment and control groups but instead made use of engineering principles which assisted in the design and construction of target instrument during the research process.

Materials Used for The Fabrication

- Pure aluminums alloy
- Mild steel bolts for fastening of the screws
- Small quantity of Silicone material was used as reforming to the aluminum
- Stainless steel rod used as screws
- Wood to form wooden pattern
- Flat bars
- Silicon carbide
- Synthetic sand was used as the refractory material

Equipment used for the Fabrication

- Drilling machine
- Hack saw
- Angle grinds
- Hammers
- Precision stone
- Chisel
- ARC welding machine
- Hand drilling machine

Procedures of Fabrication

The procedures of fabrication were through a sketch to give a brief description of a modified dental crown clamp and flask, using a wooden pattern which was made by the wood pattern maker for further explanation of the equipment in order to give an idea and picture of what the equipment will eventually result to using alloy which will serve as a guide for engineer to construct [4].

After the design, construction and necessary adjustment of the wood pattern by the pattern maker then the engineer concluded that the wood pattern will be designed in three separate segments for easy moulding, then after all examination and observation, it was then brought back to the engineering workshop for the production of the equipment (modified dental crown flask and clamp.)

The moulding procedure used for the production of clamp was three box moulding which is multi-piece pattern (cope, cheek and drag) and the moulding procedure used for the production of flask was two box moulding (cope and drag)

Aluminums alloy was subjected to a very high temperature where little amount of silicon was added and forced into the mould created by the wooden pattern using synthetic sand as the refractory materials. The purpose of the silicon added is to give the aluminum a shining surface after finishing.

The cast was finished by thorough cleaning and shining with sand paper and kerosene and then perforated with perforating machine, where it was perforated in four different parts of the clamp using screwing tools and also at the bottom according to the position of the flasks using plane tools and also an alignment marks was created on the sides of each crown flask to make it easier for the user.

Four stainless steel screw rods are inserted into the clamp to hold the flasks in their normal position. Four free bolts of mild alloy were inserted to serve as driver for the stainless-steel screws to fasten the flasks in their normal position.

Mounding and Casting Procedure of the Crown Flask (Aluminum Pattern)

Pattern Making Tools

- Tape rule
- Contraction rule
- Bevel rule
- Spoke shave
- Hammers
- Chisel
- Vermeer calipers

Mounding Tools

- Trowel
- Mounding box
- scrapper
- brush
- bellow
- parting powder
- Lifters and cleaners
- Spade
- Moulid board
- mold pin
- Sprig
- Strike off bar

Moulding Process

- Lubricant was applied on the pattern (pattern polish).
- The drag, that is (box) was placed on the mould board filled with facing sand (green sand) and was rammered.
- The pattern was also filled with facing sand that is the areas that has self-core and was placed on top of the drag and was pinned with mould sprig. The sprig was used to reinforce the core so that molten metal will not push the core from its original position not to have defective casting that is mismatch and short run.
- The mould containing the pattern crown flask was opened and dressed with the aid of hand trowel and hearth and square. Loose particles of sand were blown off with (bellow).
- The second box called cope was placed on the drag.
- Some parting powder was applied on the surface of the mould to prevent the two surfaces from sticking together.
- Facing sand was also introduced to the mould after placing the ingate.
- Some rammering was done to enable the sand to compact together until the box is filled up.
- Pouring basin was cut out after withdrawal of the pipes.
- The mould was opened and the pattern was removed.
- A cavity was formed; as well loose particles of sand were blown off. Hard trowel was used to dress the mould, cutting of ingate to the cavity; the cope was refined to the drag to form a complete mould waiting for molten metal.

Melting

some aluminum scrap was charged in the crucible pot into the blacksmith hearth, and little quantity of silicon was added to reinforce the aluminum. The hearth was ignited with fire, the heart is manually operated. The hand of the blower was turned manually while the heating was going on until the aluminum becomes molten at 6600c [5].

Casting: when the metal had become molten, it was removed from the furnace. Some quantities of slag or impurities were removed to obtain the pure metal and were poured on the mould; the mould was allowed to solidify for some minutes. A casting was formed.

Fettling: The casting was taken to fitting shop for fettling cutting of the ingate and file to size using hand file and sand paper [6].

Fabrication of the Clamp

- A steel bar of Diameter 12mm and length 140mm was obtained.
- A centre hole was created using a center drill bit.
- Continuous drilling was carried out using series of drills of diameter 5mm, 12mm, 13mm, 15mm up to hole on the turn piece to a depth of 9mm. It was bore to size to a depth of 8mm and to size as well as to have the bottom lip for the sitting of the spring slit off to the required length.
- The top washer was turned off to a diameter of 25mm and thickness of 1.5mm and hole of 13mm diameter and makes the recess to size of 14mm diameter and depth of 8mm.
- Also, another washer of diameter 25mm and thickness of 1.5mm and turn the recess of 13mm diameter and depth of 8mm and drilled with a drill of 3mm diameter on the centre.
- Mark out and drill the required hole at the required points on the work piece with the required sizes of twist drills on the drilling machine.
- Tap the holes required to be tapped with the correct size of taps for the definition of the thread.
- Turn the stud screw or bolt to be used and cut the thread on them, that is the two numbers of stud screws and bolt with nuts.
- Obtain the correct thickness of the top bracket.
- Shape to the correct shape and size after marking it out.
- Drill to the free end holes with the correct size of drills on the drilling machine as the center hole with the correct tapping size of drill and tap with the correct size of tap.
- Prepare the adjustment screw to size and position.
- Assemble all the parts together to their correct position as specified.
- The mould is ready for use after spraying to wear a good look and to prevent some parts of the clamp from corrosion with the aid of red oscide for coating.

Results of Data

Analysis of Personnel Data of the Respondents (Engineers)

Table 1: Distribution According to Sex

Sex	Frequency	Percentage %
Male	7	70%
Female	3	30%
Total	10	100%

Source: Researcher field survey, August 2017

The above table shows that 6 (70%) of the respondents were Male, while the remaining 4 (30%) were female.

Table 2: Education Status of the Respondents

Educational status	Frequency	Percentage %
ND/ HND	4	40%
B. TECH/PGDE	4	40%
PGDE/MS.C	2	20%
OTHERS	-	0%
Total	10	100%

Source: Researcher Field Survey, August 2018.

From the above table, 4 (40%) of the respondent has ND/HND qualification, 4 (40%) of the respondent has B. TECH/PGDE qualification, 2 (20%) of the respondent has PGDE/MS.C qualification while none of the respondents fall under Ph.D.

Table 3: Marital Status of the Respondents

Marital Status	Frequency	Percentage %
Single	2	20%
Married	8	80%
Divorced	-	0%
Total	10	100%

Source: Researcher Field Survey, August 2018

The table above shows that 2 (20%) of the respondents are single, 8 (80%) are married and none of the respondents divorced.

Table 4: Distribution According to Age Range

Age range	Frequency	Percentage%
25-34 yrs	6	60%
35-44 yrs	3	30%
45-54yrs	1	10%
55 and Above	-	0%
Total	10	100%

Source: Research field survey, August 2018.

From the above table, 6 (60%) of the respondent are between the age 25-34 years, 3 (30%) of the respondent are between 35-44 years of age, 1 (10%) of the respondents in between the ages range 45-54 years while none of the respondents falls under 55 and above years of age.

Table 5: Distribution According to the Year of Experiences

Marital Statues	Frequency	Percentages %
1-5 years	6	60%
5-10 years	4	40%
10-20 years	-	0%
20 Years and Above	-	0%
Total	10	100%

Source: Researcher field survey, August 2018.

According to the above table, 6 (60%) of the respondents said they have 1-10 years of experiences in dental profession, 4 (400%) of the respondent said they have 11-20 years of experience while none of the respondent has 21-30 years and 30 years and above experience [7].

Table 6: Do you think it will be possible to Fabricate Local Dental Crown Flask and Clamp in Nigeria through Research Work?

Respondents	Frequency	Percentages
Yes	3	100%
No	0	0%
Totals	3	100%

Source: Researcher field survey, August 2018.

From the above table, 3(100%) of the respondents were said yes, that is no none of the respondents answer No. the response to question number one is very interesting, it gave us grantee to proceeds on this project

Table 7: Have you constructed any local equipment in your company before?

Respondents	Frequency	Percentage
YES	3	100%
NO	-	0%
Total	3	100%

Source: Researcher field survey, August 2018

From the above table, 3(100%) of the respondents answer yes, meaning that all of them have the knowledge of fabricating local equipment and instrument. The responses of the respondents on this question also boost our moral to have direct focus on this research [8].

Table 8: Based on the sample given to you sir, do you agree that there will be raw materials to fabricate it as a local dental crown clamp and flask?

Respondents	Frequency	Percentage
Yes	3	100%
No	0	0%
Total	3	100%

Source: Researcher field survey, August 2018.

The above table shows that 3 (100%) of the respondent said (yes) that there will be raw materials for the production of the sample (local dental crown clamp and flask) this shows that, to fabricate local crown dental clamp and flask is not a problem in Nigeria.

Table 9: Can local fabricated ones give body smooth like imported ones?

Respondents	Frequency	Percentage
YES	3	100%
N0	0	0%
Total	3	100%

Source: Researcher field survey, August 2018.

The above table shows that, 3(100%) of the respondents answer yes, none of the respondent said N0.

Results of Product Assessment by Dental Technologists

Table 10: These deals with the characteristics and qualities of the product

S/N	Qualities/characteristics	Excellent	V. good	Good	Average	Poor
1	Strength of the product	3	2	2	O	O
2	Neatness of the product	1	4	3	0	0
3	Acceptable in dental technology Practice	2	5	3	0	0
4	General comparison with foreign ones	1	5	2	0	0
5	Portability of the product	3	5	3		
6	Usability (conduction of heat and corrosion resistance)	2	4	1		
7	Durability of the product	2	5	2		




The resultant flask and clamp have same properties when compared to those imported. The characteristics of the constructed flask and clamp include:

- Light in weight, this makes the technologist to be comfortable with its usage.
- It is nontoxic to human handling.
- It is easy to recycle.
- Aluminum can be joined by welding, brazing, soldering, riveting by means of a number of mechanicals assembles such as nuts, bolts and screws.
- Aluminum is an excellent conductor of heat which enables the transmission of heat into the mould made of plaster of Paris or other gypsum products [9].

Aluminum has a melting point of 6600c. At this temperature it is not possible for it to dissolve in water during processing Alignment mark was also made for easy manipulation.

The constructed crown flask and clamp were validated and tested by using it for the fabrication and curing of acrylic jacket crown.

Conclusion

In a research of this nature, the result of this project is positive and courageous. Various steps are taken to find solution to identified problem. The researchers identified the problem of high cost of importation of some dental instruments and decided to find out possible ways of producing these instruments using locally sourced metallic materials.It was reveals that in Nigeria, we have knowledgeable engineers that can helps us to fabricate many equipment and instruments needed in dental technology practice. At the end of this noble research, we discovered that, the product was commendable because this modified dental crown flask was never fabricated by anybody in the field of study or in the literatures. This is very clear that dental technology is an aspect of engineering based on the results of this project. Researchers hereby advice undergraduates and dental Practitioners in Nigeria to support empirical research work that will enhance local fabrication of dental instruments and equipment to promote dental technology profession in Nigeria.

Recommendations

Based on the procedures and experience the researcher encountered in the course of this study the following recommendations are hereby suggested:

- The Department of Dental Technology should liaise with the material and metallurgical engineering department on how best to produce these instruments and others that will aid the teaching and learning of dental technology in the laboratory.
- Effort should be made by senior dental practitioners to organize training, seminar/ workshop for dental students and personnel's on how to go about the fabrication of dental equipment. This should be handled by the researchers who have once worked on the local fabrication of dental equipment.
- Individuals or group who are financially capable should invest in the production of dental instrument that will foster technological development.
- Dental personnel's in the field and dental student in training should be encouraged to shift their focus on how to produce local substitute of dental equipment which is cheap and dependable.

References

1. Hornby, A. S. (2000). Oxford advanced learner's dictionary of current English (5th ed.). Oxford University Press.
2. Metallurgy. (2009). Encyclopædia Britannica 2009 Student and Home Edition. Encyclopædia Britannica.
3. Metallurgy. (2009). Microsoft® Encarta® 2009. Microsoft Corporation.
4. Ekpe, O., & Okorafor. (2008). Introduction to engineering materials. Mc Computer Press. https://www.academia.edu/29586362/INTRODUCTION_TO_COMPUTERS_IN_MECHANICAL_ENGINEERING
5. Okoronkwo, S. C., Eyarefe, O. S., Okpe, C. P., & Mbelede, L. O. (2021). Metallic prosthodontics: Principles and procedures in dental technology (ISBN 978989933914). Neofirm Printing House.
6. Shaw, F. G., & Scott, D. C. (1968). Practical exercises in dental mechanics (3rd ed.).
7. Nkuma-Udah, K. I. (2009). Lecture notes on ENG 501: Biomedical devices design.
8. Metallurgy. (2010). Wikipedia: The free encyclopedia. https://www.wikipedia.com
9. Osborne, J. (1970). Dental materials for students (6th ed.). Blackwell Scientific Publications. add references