***Original article***

# The effects of adding zirconium oxide Micro-particles to high impact polymethyl methacrylate on some mechanical properties

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## ABSTRACT

**Aim**: The purpose of this study was to investigate the transverse strength and impact strength of high impact heat-cured Poly (Methyl Methacrylate) (PMMA) reinforced with zirconium oxide particles ($ZrO_2$).

**Materials and Methods**: A total of sixty specimens were fabricated for each test. The denture base materials evaluated in this study were divided equally into three groups (A), (B) and (C) for each test. group (A) control group, unmodified high impact heat cured (PMMA). Group (B) & (C) high impact heat cured (PMMA) reinforced with 5% & 10% ($ZrO_2$) powder respectively by volume. The transverse strength was measured using the three point bending test. The impact strength was measured using the Chrapy impact tester. The micro-structural study of the fracture surfaces of test specimens was performed using Scanning Electron Microscope.

**Results**: Statistical analysis were conducted on the data obtained from the experiments using one way analysis of variance(ANOVA).Both the transverse strength and impact strength of high impact heat cured PMMA reinforced with treated $ZrO_2$ particles were superior to the unreinforced high impact heat cured PMMA. However, the improvement in transverse strength was not directly proportional with the amount of filler particles. Scanning electron micrographs showed the degree of bonding between the filler particles and PMMA matrix.

**Keywords**: high-impact PMMA, transverse strength, impact strength, zirconium oxide.

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## INTRODUCTION

The most commonly used material in construction of denture base is Polymethyl methacrylate (PMMA) acrylic resin due to its low cost, light weight, ease of processing and repair good adaptation and ease of application, and usage in tooth or implant-supported removable/complete prostheses and orthodontic appliances [1]. However, it is still far from an ideal in fulfilling the mechanical requirements of prosthesis [2]. Several attempts have been made to improve the mechanical properties of the denture base material to be useful in points where masticatory forces are relatively high, such as distal extensions opposing natural teeth, single complete dentures, overdentures, and implant-supported complete dentures, such as the chemical modification of PMMA, reinforcement with glass fibers, Carbone fibers, aramide fibers, metal wire, titanium oxide, silicone dioxide hydroxyapatite [3,4]. However, there are a lot of drawbacks to using these additives such as poor adhesion and corrosion of metal wires [5] and tissue irritation due to fibre reinforcement [6]. (Smith., 1961) analyzed the practical situation for fracture of dentures and showed two types of failure. Failure caused by impact forces, i.e., a high stress rate extra orally and failure usually in function; this is probably a fatigue phenomenon, i.e. a low and repetitive stress rate intra orally [7]. Aiming to improve the mechanical properties, some inorganic fillers were used to reinforce the PMMA denture base [8]. The selection of $ZrO_2$ as a filler in this study was based on the properties of this filler which can improve the mechanical properties of the reinforced PMMA matrix. such as impact strength and transverse strength [9-11].

## MATERIAL AND METHODS

The transverse and impact strength laboratory tests for denture base materials were performed in this study. Sixty specimens were prepared for each test which were categorized equally into three groups according to the type of used denture base material. Group (A) was the control group (unmodified high impact acrylic resin - idobase specimens). Group (B) & (C) specimens made up of high impact heat curing (PMMA) reinforced with 5% & 10% $ZrO_2$ powder respectively by volume after their treatment with silane coupling agent 3-methacryloxypropyl-trimethoxysilane (Monobond-S). The treated $ZrO_2$ powder (20µm-30µm) was thoroughly mixed with acrylic powder using a mortar and pestle for initial mixing and blending, then hand tumbling in a plastic jar was performed to achieve an even color [12,13]. In the present study, 3-methacryloxypropyl-trimethoxysilane (Monobond-S) has been used as s silane coupling agent to improve the bond between the surface of $ZrO_2$ powder and PMMA particles for groups (B & C). Each 30 gm of $ZrO_2$ powder was treated with solution of 0.3 gm of coupling agent in 100 gm of acetone. A magnetic stirrer was used for stirring the metal oxide powder in the coupling agent / acetone solution for 60 min, followed by complete evaporation of acetone [14].

*Transverse Strength Test*:

The object of the test is to evaluate the behaviour of denture base polymer under bending loads. Metallic mold having the dimensions of flexure strength test specimens according to the American Dental Association Specification No. 12 for denture base polymer (65 mm length, 10 mm width and 2.5 mm thickness +/_0.2mm) was constructed. Sixty wax specimens representing the dimensions of test specimens were prepared from base plate wax. These sixty specimens were divided equally into three groups of twenty specimens each. The first twenty specimens were constructed from group (A), the second twenty from group (B) and the third twenty from group (C). All specimens were processed using long curing cycle. After their removal from the flask the specimens were finished using smooth sand paper. The specimens were stored in water at 37±10 C for seven days using thermostatically controlled water path before performing transverse strength test.

## *Testing*

The specimen was mounted on the designed part of a universal testing machine, three-point loading and testing equipment (Mfd for Dayton Electric Co. Chicago 60648 USA (CEDM-4).The load was applied on the centre of the specimen with a cross head speed of 0.5 cm / min 15. The maximum load before fracture was measured. The transverse strength of the specimens was calculated using the standard relation [16].

$$S = \frac{3LP}{2WT^2} Kgs/cm^2$$

Where: S = Transverse strength, P = Maximum load before fracture, L = Distance between supports (50 mm), W = Width of the specimen (10 mm), T = Depth (thickness) of the specimen (2.5 mm).

*Impact Strength Test*:

Metallic mold having the dimensions of impact strength test specimens according to British Standard Institute Specification No. 771, (1948) (75 mm length, 10 mm width, and 10 mm thickness with a notch of 2 mm depth at the mid-span was constructed. The number of the test specimens, their divisions and the protocol of testing was the same as flexural strength test.

## *Testing*

The specimen was accurately mounted in the vice of the pendulum testing machine (Charpy type impact test).The specimen was struck at the mid-span by the pendulum as it was released out of position (The force was applied to the specimen from the unnotched side)[16]. Reading was directly given and recorded on the scale by the silent arm of the double moving pointer. The impact strength of the specimen was expressed in term of $J/m^2$ of energy absorbed in breaking the specimens [17].

Scanning electron microscope (SEM) observation:

SEM (JEOL-JSM 5300) was used to examine the fractured surface of the randomly selected specimens. The electron voltage used in this study was set at 15 Kv. The examined specimens were gold coated using a sputtering machine (ION SPUTTERING DEVICE / JEOL – JFC – 1100E).Images were obtained with different magnifications.

## RESULTS

The mean, SD and P- values of the specimens tested for transverse strength are presented in (Table 1 & Figure 1). It shows a significant increase in transverse strength values in group (B) when compared to group (A) (P 0.001) & (T= -3.769). Asignificant increase in transverse strength values was also observed in group (B) when compared to group (C) (P 0.032) & (T=2.318). However the increase in transverse strength was statistically insignificant when

group (C) and group (A) were compared (P 0.575) & (T= -0.313).

The mean, SD and P-values of the specimens tested for impact strength are presented in (Table 2 & Figure 2). It shows a significant increase in impact strength values in group (B) when compared to group (A) (P 0.006) & (T= -3.086). Also a significant increase in transverse strength values was observed in group (C) when compared to group (A) (P 0.001) & (T= -3.897). However the increase in transverse strength was statistically insignificant when group (C) and group (B) were compared (P 0.501) & (T= -686).

Scanning electron microscope (SEM) was used to view the fracture surface of different test specimens to assess the shape, size and distribution of the filler particles within the fully cured composite. The size of the $ZrO_2$ filler particles was 20µm to 30µm

Micrograph of fractured surface related to control group (A) (Figure 3 a & b) showed a flake like morphology and a smooth surface with small pits and cracks compared to other test specimens related to other groups. The fractured surfaces of reinforced groups (B & C) exhibited rough surface with varying morphological features of reinforcing particles which generally was round (Figure 4). The voids formed due to $ZrO_2$ particles that pulled out were clear (Figure 5).

**Table 1: Comparison of transverse strength (Mpa) between different Groups**

| GROUPS | A | B | C |
|---|---|---|---|
| Mean ± SD | 98.91 ± 1.096 | 100.75 ± 1.089 | 99.13 ± 1.925 |
| T-test(P) | -3.7690.001a* | 2.3180.032b* | -0.3130.575c |

a. Comparing group A with Group B.
b. Comparing group B with Group C.
c. Comparing Group A with Group C.
*Significant, p ≤ 0.05.

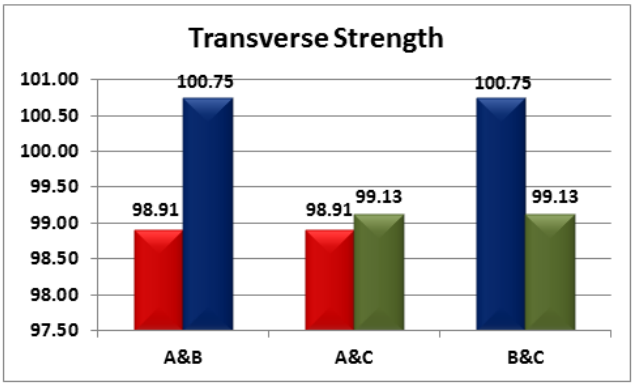


**Figure 1: Comparison between the mean values of transverse strength of different groups**

**Table 2: Comparison between the mean values of impact strength of different groups**

| GROUPS | A | B | C |
|---|---|---|---|
| Mean ± SD | 3493.06 ± 52.59 | 3591.58 ± 86.19 | 3618.13 ± 86.79 |
| T-test(P) | -3.0860.006a* | -.6860.5b | -3.8970.001c* |

a. Comparing group A with Group B.
b. Comparing group B with Group C.
c. Comparing Group A with Group C.
* Significant, p ≤ 0.05.

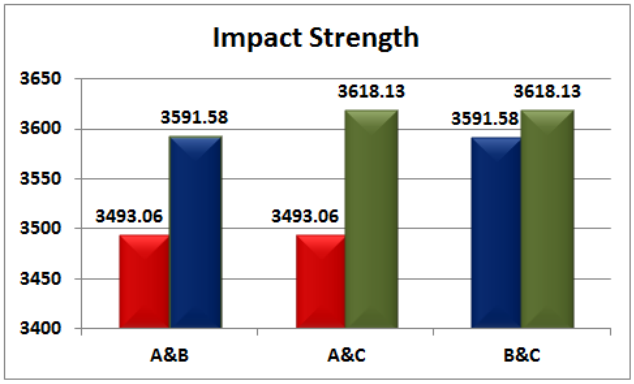

**Figure 2: Comparison of impact strength (J/m2)**

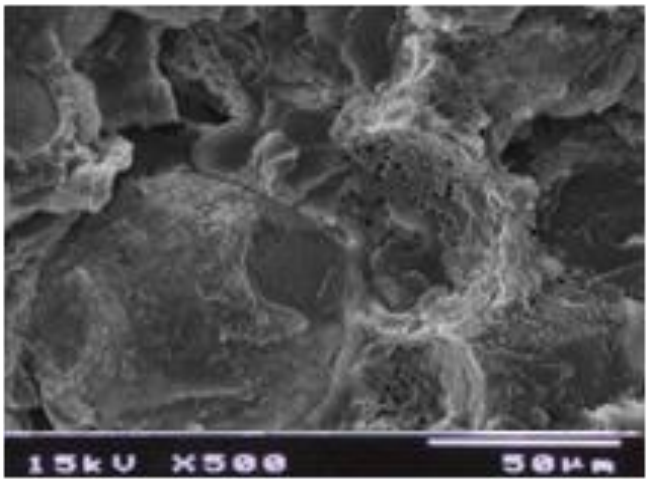


**Figure 3 (a)**

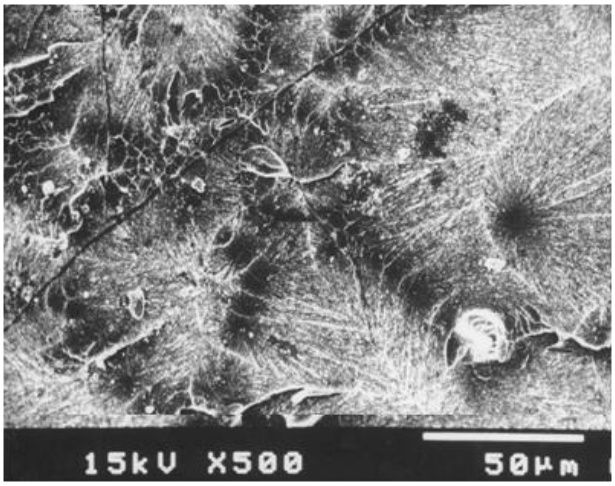


**Figure.3(b)**

**Figure 3: SEM micrograph showing the fracture surface of PMMA specimen (Original Mag.x 500)**

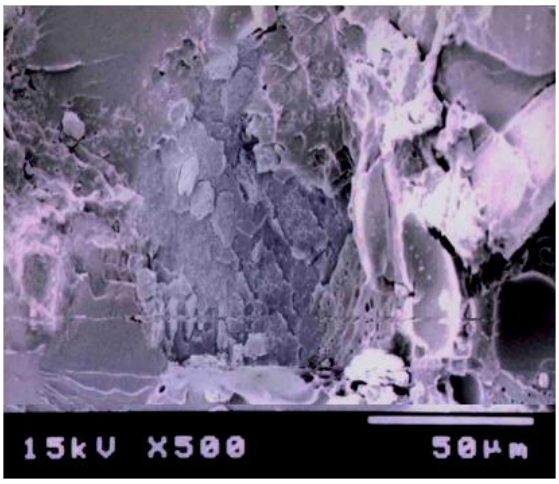


**Figure 4: SEM photograph of the fractured surface of ZrO2 filled specimens. ( Orig. Mag×1000)**

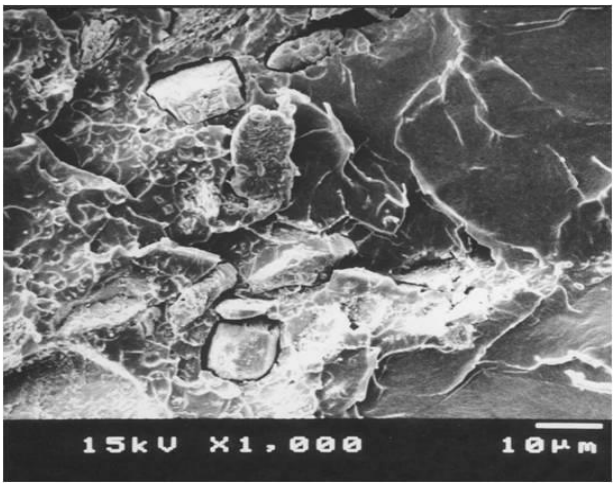


**Figure 5: SEM photomicrograph showing the voids formed due to ZrO2 particles pulled out (Original Mag x 500)**

## DISCUSSION

In general, the PMMA denture base material is prone to fracture either intraorally or extraorally due to its poor mechanical properties. To overcome this drawback, PMMAs are reinforced with a verity of additives to improve their strength [9,18].

Only a few studies on the effect of adding $ZrO_2$ micro-particles in high impact heat-cured PMMA are available in the literature. In contrast, investigators have worked on improving the mechanical properties of conventional heat-cured denture base acrylic resin by incorporating different types of fillers [19,20].

The aim of the current study was to evaluate the effect of adding $ZrO_2$ micro-particles at low

volume fractions (5% and 10%) after their treatment with silane coupling agent on the transverse and impact strength properties of high impact PMMA denture base material without adversely affecting the esthetic. All tested specimens were stored in a water at about 37± 1 cofor seven days to simulate the wet condition inside the oral cavity. The results found that all tested groups showed increased transverse strength and impact strength. However, this improvement was not in direct proportion to the concentration of filler particles.

According to the results of the current study, a significant increase in transverse strength was found with the addition of 5% $ZrO_2$ particles while the improvement was not significant with the addition of 10% $ZrO_2$ particles. Moreover, the addition of 10% $ZrO_2$ resulted in decrease in transverse strength as compared with 5% $ZrO_2$. The amount of filler incorporated to reinforce the acrylic resin is a factor affecting the mechanical properties [21].

The percentage of reinforcing filler should be in such amount that will disperse evenly into the resin matrix without gross disruption in its continuity [22]. The improvement in the flexural strength could be due to good dispersion of the micro size $ZrO_2$ particles which assists in filling of the matrix interstitially [23]. Furthermore, The small particle size of the filler provides maximum surface area for bonding to resin. The employment of silane bonding Monobond-S (3-methacyloxypropyl-trimethoxysilane) in this study due to its benefit for bonding of inorganic composite fillers to organic matrix permitting better transfer stress from PMMA to fillers, thus leading to an improvement in the equivalent transverse strength of the composite [23]. It also makes the mixture more homogenous, resulting in stronger PMMA [24,25].

In this study the improvement in transverse strength decreased as the concentration of the filler particles increased which could be attributed to the agglomeration of incorporated particles, acting as stress concentration centres in the matrix and unfavourably decreasing the mechanical properties of the resin [13,26]. Moreover, the agglomerated fillers lead to formation of loose attached clusters, which affect the mode of crack propagation, reduces the transverse strength [26,27]. This finding was in agreement with some previous studies, [28,29] while in disagreement with others [10,30].

With the addition of 5% and 10% filler particles there was a significant improvement in impact strength as compared to control group. This could be due to the transfer of the applied load to the filler particles through a relatively soft ductile matrix which became the principal load – bearing constituents [31]. However, this improvement was not significant with the addition of 10% $ZrO_2$ particles as compared with the addition of 5% $ZrO_2$ filler particles which considered to be due to the large number of surface irregularities produced by the extrusion of filler particles (debonding), since a significant reduction of impact resistance of PMMA to the presence of very small surface defects is well known [31,32]. Furthermore, the distribution of $ZrO_2$ micro-particles in the polymer matrix particularly at high $ZrO_2$ concentrations 10% by volume was not homogeneous with evidence of agglomerations, which could reduce the impact strength[19].

**Conclusion:** with consideration to the limitations of the present study, The results of this study conclude that addition of $ZrO_2$ micro-particles powder 5% and 10% by volume to the high impact strength heat cure acrylic resin reveals an increase in both transverse and impact strength of reinforced resin. However, the improvement in transverse strength was not in direct proportion with the amount of filler particles.

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***Original article***

# Endoscopic Endonasal Dacryocystorhiniostomy (EEDCR) (Libyan Experience)

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***ABSTRACT***

*Endoscopic endonasal dacryocystorhiniostomy (EEDCR) is a valid alternative to external procedures in the management of nasolacrimal duct obstruction with success rate ranging from 82% to 95% . It is a less invasive procedure, can be done both under general and local anesthesia*

***Patients and methods:*** *In the present study twenty patients (18 Females and 2 males), aged 17 to 65 years were studied in the period between May 2009 to March 2010* to determine the success rate of such operations. All cases were operated under general anesthesia with the help of zero endoscope and drill of lacrymal bone.

**Results:** Stents were applied in 5 recurrent cases after failed external approach, unresolved acute dacryocystites with abscess formation, and dacryocystocele. Few complications were encountered (such as granulation tissue at operative site in 4 cases, recurrence of symptoms due to incomplete removal of mucosal flap, and synechia between lateral nasal wall and middle turbinate).

**Conclusion:** After a follow up of 6 months the success rate in this series was 95%. Thus it is suggested that stent application should not be carried out routinely in every case, while close and regular follow up helps early identification of complications, early intervention and hence it decreases the recurrence and revision surgery.

**Key words: Endoscopy, dacryocystorhiniostomy, nasolacrimal duct obstruction, Libyans.**

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## INTRODUCTION

*External approach dacryocystorhiniostomy (DCR) was first described by Toti in 1904 [1], whereas the first intranasal approach was described by Caldwell in 1893 [2] McDonough and Meiring [3] had described endoscopic endonasal DCR in 1989. Stenosis of the nasolacrimal drainage system is encountered in clinical practice by both ophthalmologists and otorhinolaryngologists [4]. The symptoms of nasolacrimal duct (NLD) blockage include excessive watering, mucous discharge, eye irritation and painful swelling in inner corner of eye lids. Untreated cases may lead to recurrent eye infection.*

*Preoperative evaluation is an important step p*rior *to surgery and consisted of a standard examination which included lacrimal irrigation, probing, dacryocystography (DCG) and osteomeatal unit (OMU) computed tomography [5]. Irrigation of the lacrimal system establishes correct diagnosis, being an easy, safe, and low cost examination [6].*

*Surgery is an effective treatment and the most effective surgery is DCR, In which bypass the obstruction by creating a new drainage at the sac. Incision can be done at skin (external approach) or inside the nasal cavity. Both of these approaches improves quality of life [7], Endoscopic endonasal DCR is a valid alternative to external procedures in the management of NLD obstruction with success rate ranges from 82% to 95% [8], it is a less invasive procedure, can be done both under general and local anesthesia [9,10].*

*Contemporary technology, with the introduction of endoscopes and imaging investigations dedicated to the nasolacrimal system,*

*allows the site of the obstruction to be detected and to perform micro-invasive surgery, respecting the anatomical structures [3,11,12]. Stent is used when needed in both external and endoscopic approach [2,3,13]. Some surgeons use otologic T-type ventilation tube instead of stent tube in recurrent cases [14] Complete removal of the medial wall of lacrimal sac after its identification increases success rate. The use of indocyanine green (ICG) gel, a mixture of ICG and Viscoat injection in the inferior canaliculus helps in identification of the sac and the complete removal of its medial wall, hence increases the success rate [15]. DCR success rate is also influenced by many factors like patients' age, duration of symptoms, occlusion site and stent insertion [16].*

## PATIENTS AND METHODS

In a period of 11 months from May 2009 to March 2010, 20 cases of chronic dacryocystities have been operated in *Hawari Hospital*, Faculty of Medicine, Benghazi University, Libya and studied prospectively. All the cases were diagnosed and referred from an ophthalmologist as a case of nasolacrimal duct obstruction that does not improve with a repeated sac washout. All cases were presented either by epiphora which was the main presenting symptom, beside recurrent dacryocystities, medial canthal swelling or history of mucopurulent eye discharge.

Endoscopic nasal approach using zero degree and rarely 30 degree endoscopes under general anaesthesia was performed. All cases were discharged next day after removal of anterior nasal pack . Systemic antibiotic therapy, local antibiotic eye drops, nasal decongestant for one week were given to these cases. Cases were followed up after 1 week, 2 weeks , 6 weeks, 3 months, and 6 months postoperatively.

### *The operation*

Under general anaesthesia (GA), the identification of maxillary line, curvilinear bony eminence that runs from anterior attachment of middle turbinate vertically (through lacrimal fossa) down to root of inferior turbinate which represent attachment of maxillary & lacrimal bone (Figure 1) was done.

Injection of diluted adrenaline at the site of maxillary line was carried out followed by removal of 1 cm circle of mucosa over suspected position of the sac by sickle knife, then drilling of bone at maxillary line. The sac was felt by pressing at medial canthus and notice the movement intranasly. Once a small opening in the bone is made, enlargement of this opening is done by punch forceps, incision of the medial sac wall is done by sickle knife. When milky secretion is noticed, then medial mucosal wall of the sac was completely removed. Stent when needed is inserted through superior and inferior canaliculi. The two sides of the stent was identified at the incised lacrimal sac site and tied it intranasaly. Light nasal pack is kept to control bleeding at the operation site. No additional surgery was performed like septoplasty or partial turbenectomy to improve sac exposure.

### *Post operative care*

The removal of light anterior nasal packing was done in the next day, frequent nasal suction, daily normal saline irrigation, and removal of granulation tissue at operation site if present on follow up. Success rate or patency of lacrimal system verified by: absent symptoms (epiphora or chronic medial canthal swelling) and endoscopic visualization of saline flowing from the eye through to the nose.

## RESULTS

This study included 20 cases, their age ranged from 17 years to 65 years with a mean age of 37.9 years. Fifteen (90%) of the cases were females and 5 (10%) were males (Figure 2).

### *Stents were only used in case of :*

1. Recurrence after external approach.

2. Unresolved acute dacryocystites with abscess formation.

3. Dacryocystocele.

Epiphora was the most frequent presenting symptom. A total of 15 cases have been operated without stent insertion where as the other 5 cases was done with stent (Figure 3).

### *Complications and difficulties:*

Granulation tissue at the operation site was reported post operatively in 4 cases. Recurrence in one case due to incomplete removal of mucosal flap that get adhered at the new stoma is reported. In this case revision with stent application for 6 months was done and in another case of synechia between middle turbinate &lateral wall was encountered. Removal of granulation tissue and release of synechia was done under local anaesthesia in the follow up period, as shown in (Figure 4).

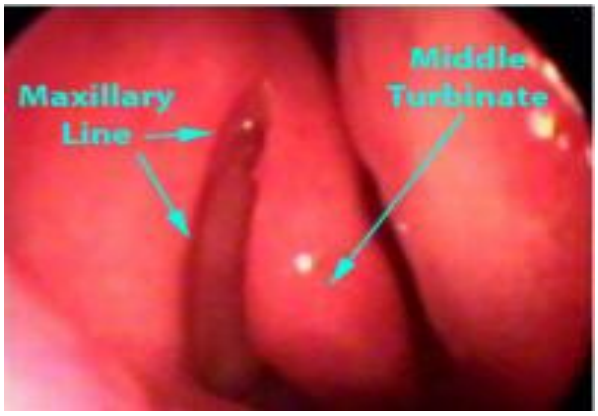
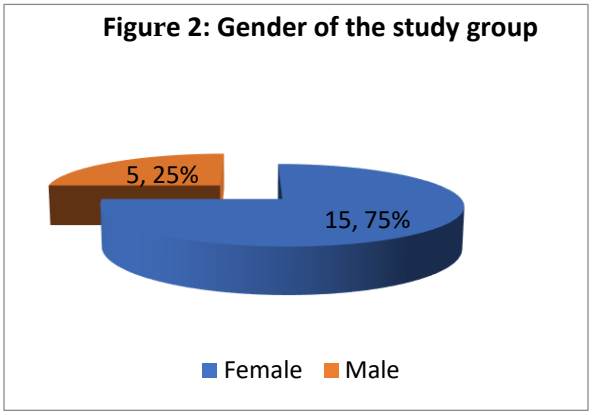
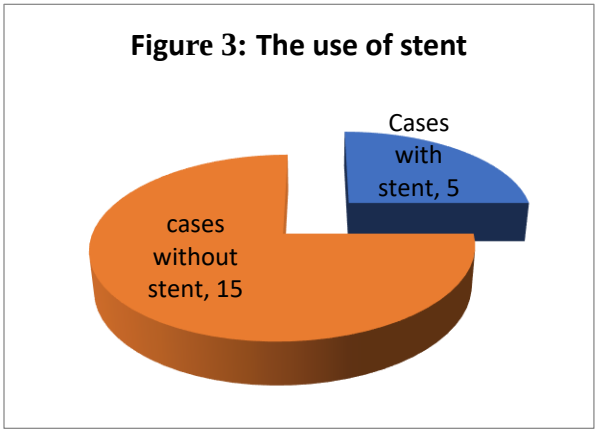
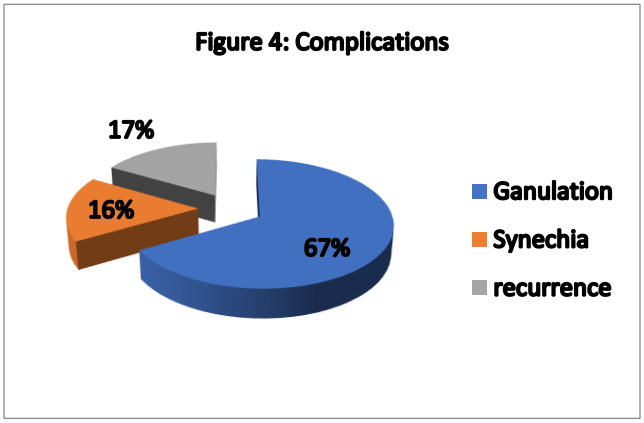



Figure 3: The identification of site of drilling at maxillary line



## DISCUSSION

Most of the cases in our study are female patients which may be due to long term use of cosmetics that causes alteration in lacrimal pathway [17]. Success in DCR surgery mainly depends on creating awide stoma and preservation of mucosa aroundlacrimal window to reduce chances of postoperative scarring and stenosis [9,18]. Success rates for endoscopic dacryocystorhinostomy varies from 82% to 95% [4,8].Jyothi et al,reported a success rate of 95% using silicone stent for six weeks only, [18] where as Jin HR, et al reported a lower success rate of 83% (19) .Manor and Millman suggested that lacrimal sac anatomy is an important prognostic factor for successful EDCR(20) as fibrosed sac increases risk of recurrence.

Unlu et al, described a 90.5% success rate in EDCR without the use of silicone tube or stent. The rhinostomy opening was maintained during the post operative period with regular removal of nasal crust and the use of eye drops [21]. It has been reported that the presence of stent increases fibrosis of the duct and hence failure.

In the present surgical technique drilling was used to obtain access to lacrimal sac although others claimed that hot instruments such as the drill can cause more granulation tissue at the new stomal opening and instead they raised mucosal flaps, and used Smith-Kerrison punch forceps for bone removal [22]. Stents are not routinely used in our practice for every case, but we used it for those who needed it, this led to a reduction in recurrence.

## Conclusion and recommendations

After a follow up of nearly 6 months, the success rate in this series was 95%. We felt that stent application should not be applied routinely in every case, but close and regular follow up of the patients are needed to help in early identification of complications, thus an early intervention which decreases the recurrence and prevents revision surgery.

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***Original article***

# The impact of sociodemographic characteristics on oral health behaviors of dental graduates

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**ABSTRACT**

**Background**: To assess and compare oral health behaviors (OHB) of final year dental students in private and state-run dental schools in Benghazi city, Libya.

**Methods**: Students from private and state-run dental schools were invited to participate in this cross-sectional study. A self-administered questionnaire including closed ended questions regarding socio-demographics and OHBs was used. The main OHBs explored were teeth brushing, the usage of fluoridated toothpaste, dental flossing, sugar consumption, dental visiting and smoking habit. Binary logistic regression models were utilized to explore associations between OHBs and socio-demographic variables

**Results**: Out of 240 students invited, only 199 completed questionnaires were analyzed (effective response rate was 83%). The majority of the students were females (80%) who brushed their teeth daily (90.5%) and used fluoridated toothpaste (80.2%) while 30.2 % of them used dental floss and only 7% were smokers. Females were more likely to use fluoridated toothpaste (OR = 2.67, 95% CI = 1.21 – 5.97) and visit a dentist (OR = 2.31, 95% CI = 1.21 – 4.42) compared to males, and students in the private dental school consumed more sugary-snacks per day (OR = 3.2, 95% CI = 1.52 – 6.75) than those who studied in state schools.

**Conclusion**: Socio-demographic variables such as gender and type of school were associated to certain oral health behaviors of dental students.

**Keywords**: Behaviors, Oral Health, Internship, Dental School

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## INTRODUCTION

Oral health behaviors (OHB) are key players in defining oral health status. Regular brushing of teeth, using fluoridated toothpaste, regular dental visits and less consumption of sugars are behaviors associated with optimum oral health.[1] However, not everyone is capable of maintaining such behaviors even if they have the knowledge that these behaviors are a must to improve oral health.[2, 3] According to the conceptual framework for action on the social determinants of health, adopting healthy behaviors is influenced by wider socioeconomic and environmental determinants.[4] Social gradient that favors better oral behaviors and outcomes among people from higher social class has been reported in dental literature.[5-7]

Nevertheless, developing and maintaining behaviors is a complex matter manifested in various theories and explanations for behavior change. For instance, the integrative model (IM) of behavioral prediction suggests that individuals' behavior branches reasonably from the stem of their beliefs which, in turn, are shaped by their knowledge and other background factors related to attitudes, social norms, individual skills and environmental factors.[8] As dentists possess highest levels of knowledge on oral health and disease prevention, they are expected to conform to and maintain favorable OHBs and act as role models for their families and societies. However, dental schools are usually admitting students based on their academic scores regardless of their socioeconomic position. Although it has been assumed that professional training and education of dentists may outweigh the individual characteristics to produce optimum OHBs and promote better oral health. [9] Oral health related beliefs and behaviors of adults are found to be associated with their early-life social position and oral health-related beliefs of their parents.[10] Therefore, it is possible that dental students from different socioeconomic backgrounds show different levels of compliance with optimal oral health behaviors.

In Libya, most of dental schools are state-run and fees-free; though recently, a few private dental schools with high tuition fees have been established. The curriculum in these Libyan dental schools is quite similar and generally comprises three stages divided over five years: first premedical year, second stage is the preclinical (year 1 and 2) and finally clinical stage (year 3, 4 and internship year). In the clinical years, students are trained on managing and treating patients under supervision. Preventive dentistry is taught during year 3 and 4 and covers issues related to maintaining appropriate oral hygiene, oral health education and preventing dental diseases.

In 2015, A study conducted on internship students attending the dental faculty of Benghazi, revealed that Libyan dentists have varying levels of attitude and skills that are required to fulfill their role in providing preventive-oriented oral health services. It also evidenced that there were differences in students' attitudes towards and ability to practice preventive dentistry by their gender and academic performance. [11]Little is known about OHBs of Libyan dental students and to what extent can socioeconomic background influences their OHBs. Therefore, the aim of this study was to assess the OHBs of internship dental students in private and state-run dental schools in Benghazi and to compare these behaviors according to the students' socioeconomic characteristics.

## METHODS

The ethical permit to conduct this study was obtained from Research Ethics Committee at the Faculty of Dentistry, Libyan International Medical University (AA03/2015).

***Design and participants:***

This cross sectional comparative study conducted between April and August 2015. The participants were internship dental students recruited from one private (Libyan International Medical University (LIMU)) and another state-run (Benghazi University (BU)) dental schools in Benghazi, Libya. These are the only dental schools in the city in which preventive dentistry is an essential component of the dental curriculum of BDS program in both dental schools.

***Data collection:***

A self-administered questionnaire written in simple English language was used for data collection in this study. Participants provided information on their demographic characteristics (sex and age), dental school (state-run or private) and parents' education (primary, secondary or university). They also stated the frequencies of their oral hygiene practices (tooth brushing and dental flossing) using a three-point Likert scale (regular- twice or more /day, irregular-once a day or every few days, never). The questionnaire was piloted among 10 volunteering undergraduate students for face validity and clarity and it was found to be clear and understandable.

Participants were conveniently approached while doing the paperwork for their graduation certificate by two investigators (SS & NB) who explained the aim of the study and confidentiality of participation. After acceptance, a copy of the self-administered questionnaire was provided along with an envelope and the participants were asked to leave the questionnaire in the envelope at the administration office for collection the day after. The consent was implied from returned and completed questionnaires.

***Outcome and explanatory variables:***

OHBs were the outcome variables in this study. The participants answered questions about in-between meals sugar consumption (2 times per day or more, once a day, never); whether they had dental check-up during the last six months, use of fluoridated toothpaste, and if they are smokers.

The explanatory variables included information on participants' age and gender as well as parental education as a proxy of socioeconomic status. Whether the participant

was studying at a private or a state-run school was used as a proxy of family economical status due to the high tuition fees required for joining the private dental school. Another explanatory variable used in this study was the living area. Benghazi city has many administrative zones hosting citizens from the full socioeconomic spectrum. Since there is no official and reliable index of defining the social class criteria, especially between middle and low, of living areas in the cities, the city zones were classified into high and middle-low areas. Two investigators executed this independently and any disagreement was resolved by discussion.

***Data analysis:***

Data management and analysis were performed using the IBM SPSS Statistics software version 21. The numbers and percentages were used to describe frequencies of oral health related behavior. Each type of behavior was recoded to create binary responses of the following: tooth brushing, use of fluoridated tooth paste and dental flossing were coded as regular and irregular. The in-between meals sugar consumption (two times or over per day *vs* less than two times a day) whereas having dental check-up in the last six months and whether they are smokers were coded as yes or no.

Bivariate analysis using Chi-square test was used to compare reported OHBs by responder's gender, dental school type, father's education and mother's education and whether they live in affluent or low-middle class area. Binary logistic regression models were used to explore the predictors of oral health behaviors form socio-demographic variables. The significance level was set at 0.05.

**RESULTS**

Out of 240 participants invited to take part in the study, 215 returned the questionnaires but only 199 participants had completed information on all the variables selected for analysis, giving rise to an effective response rate of 83%. The majority of our sample were females, between 23 and 26 years of age, with nearly equal numbers from each dental school. Whilst the majority of their mothers had university degrees (70.9%), just less than half of their fathers had attained a university degree (49.2%) (Table 1).

Table 2 reports frequencies of self-reported OHBs. Most of the respondents reported brushing their teeth on daily basis (90.5%), using fluoridated toothpaste (80.2 %) whereas, almost one third of participants indicated regular usage of dental floss (30.2 %). Less than two in-between meals sugar intake was reported by more than half of the responders (59%). Only 7% were smokers whom all were males.

Table 3 shows bivariate comparisons of oral health-related practices by respondents' socio-demographic characteristics. There were statistically significant differences according to their gender, dental school type and father's education but not mother's education. Larger numbers of females reported regular use of fluoridated toothpaste (P=0.028) and had dental check-up within the last six months (P=0.004) but non of them was a smoker (P<0.001). Responders whose fathers have primary or secondary education levels reported higher use of fluoridated toothpaste (P=0.012). Dental graduates from state dental school and those from lower-middle social class reported lower numbers of in-between meals sugar intakes than those graduated from private dental school (P<0.001, p=0.017, respectively). After adjusting for the other variables (Table 4), gender differences remained significant for the use of fluoridated toothpaste (OR=2.67, CI=1.21– 5.97) and dental check-up within the last six months (OR = 2.31, CI = 1.21 – 4.42). Similarly, difference by dental school remained significant for in-between meals sugar consumption (OR = 3.2, CI = 1.52 – 6.75).

**Table 1: Characteristics of the study sample (n=199)**

| Female Variables | | Overall N (%) | Private | Public | P value |
|---|---|---|---|---|---|
| **Sex** | Male | 66 (32.2) | 32 (32) | 34 (34.3) | 0.421 |
| | | 133 (68.8) | 68(68) | 65 (65.7) | |
| **Father's Education** | Primary | 33 (16.6) | 3 (3) | 30 (30.3) | <0.001 |
| | Secondary | 68 (34.2) | 29 (29) | 39 (39.4) | |
| **Mother's Education** | Primary | 14 (7) | 4 (4) | 10 (10.1) | 0.001* |
| | Secondary | 44 (22.1) | 13 (13) | 31 (31.3) | |
| | University | 141 (70.9) | 83 (83) | 58 (58.6) | |

| | | | | | |
|---|---|---|---|---|---|
| **Social class of living area** | Low and middle | 122 (61.3) | 36(36) | 86(86.9) | <0.001* |
| | High | 77 (38.7) | 64(29) | 13(13.1) | |

**Table 2: Self-reported oral health related behavior (n=199)**

| Behavior | **N (%)** |
|---|---|
| Daily teeth brushing | 180 (90.5) |
| Regular use of fluoridated tooth paste | 164 (82.4) |
| Regular use of dental floss | 60 (30.2) |
| Less than 3 sugary snacks per day | 140 (70.2) |
| Dental check up within the last 6 months | |
| Smokers | 14 (7) |

**Table 4: Predictors of oral health related behaviors (n=199)**

| **Variables** | **Daily teeth brushing** | **Regular use of fluoridated tooth paste** | **Regular use of dental floss** | **>3 sugary snacks per day** | **Visited dentist within the last 6 months** |
|---|---|---|---|---|---|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| **Sex** | | | | | |
| **Male** | Ref | Ref | Ref | Ref | Ref |
| **Female** | 2.04 (0.76, 5.46) | 2.67 (1.21, 5.97) * | 1.21 (0.62, 2.34) | 1.1 (0.59, 2.14) | 2.31 (1.21, 4.42) * |
| **Dental School** | | | | | |
| **Public** | Ref | Ref | Ref | Ref | Ref |
| **Private** | 1.50 (0.43, 5.73) | 2.48 (0.91, 6.82) | 1.11 (0.52, 2.35) | 3.2 (1.52, 6.75) ** | 0.70 (0.32, 1.51) |
| **Living area** | | | | | |
| **Low & middle** | Ref | Ref | Ref | Ref | Ref |
| **High** | 2.50 (0.69, 9.11) | 1.42 (0.55, 3.67) | 1.33 (0.63, 2.83) | 1.2 (0.40, 1.69) | 1.05 (0.48, 2.28) |
| **Father's Education** | | | | | |
| **Primary** | Ref | Ref | Ref | Ref | Ref |
| **Secondary** | 2.29 (0.51,10.25) | 1.83 (0.49, 6.82) | 1.46 (0.48, 4.39) | 1.8 (0.62, 5.53) | 0.72 (0.24, 2.11) |
| **University** | 1.51 (0.28, 7.99) | 0.37 (0.10, 1.46) | 1.66 (0.52, 5.35) | 1.1 (0.33, 3.57) | 0.77 (0.23, 2.53) |
| **Mother's Education** | | | | | |
| **Primary** | Ref | Ref | Ref | Ref | Ref |
| **Secondary** | 1.59 (0.27, 9.34) | 0.24 (0.02, 2.43) | 1.03 (0.21, 5.02) | 0.7 (0.17, 3.37) | 1.68 (0.41, 5.66) |
| **University** | 3.79 (0.61, 23.55) | 0.65 (0.06, 6.78) | 1.41 (0.30, 6.56) | 0.7 (0.17, 3.21) | 3.12 (0.77, 12.58) |
| | | | | | |

*The corresponding categories of the dependent variables are the following; irregular use of tooth brush, fluoridated toothpaste, dental floss and less than 3 sugary snacks per day. Ref = Reference category. Superscripts indicate where differences were located. ** p≤0.01, *p≤0.0.*

**Table 3: Comparison of oral health related Behaviour by participants' characteristics (n=199)**

| Variables | Daily teeth | Regular use of | Regular use of | More than 3 | Visited dentist | Smokers |
|---|---|---|---|---|---|---|
| **Sex** | | | | | | |
| **Male** | 57 (31.7) | 49 (29.9) | 18 (30.0) | 25 (31.2) | 39 (27.9) | 14 (100) |
| **Female** | 123 (68.3) | 115 (70.1) | 42 (70.0) | 55 (68.8) | 101 (72.1) | 0 (0) |
| **P value** | 0.167 | 0.033* | 0.533 | 0.638 | 0.014* | 0.000 |
| **Dental School** | | | | | | |
| **Public** | 88 (48.9) | 79 (48.2) | 28 (46.7) | 26 (32.5) | 72 (51.4) | 7 (50.0) |
| **Private** | 92 (51.1) | 85 (51.8) | 32 (53.3) | 54 (67.5) | 68 (48.6) | 7 (50.0) |
| **P value** | 0.455 | 0.335 | 0.568 | 0.000 | 0.465 | 0.984 |
| **Living Area** | | | | | | |
| **Middle-poor class** | 111 (61.7) | 101 (61.6) | 37 (61.7) | 39 (48.2) | 86 (61.4) | 9 (64.3) |
| **Affluent class** | 69 (38.3) | 63 (38.4) | 23 (23.2) | 41 (51.8) | 54 (38.6) | 5 (35.7) |
| **P value** | 0.748 | 0.861 | 0.945 | 0.017 | 0.957 | 0.812 |
| **Father's Education** | | | | | | |
| **Primary** | 27 (15.0) | 27 (16.5) | 7 (11.7) | 08 (10) | 23 (16.4) | 3 (21.4) |
| **Secondary** | 63 (35.0) | 61 (37.2) | 20 (33.3) | 31 (38.8) | 46 (32.9) | 2 (14.3) |
| **University** | 90 (50.0) | 76 (46.3) | 33 (55.0) | 41 (51.2) | 71 (50.7) | 9 (64.3) |
| **P value** | 0.358 | 0.129 | 0.397 | 0.109 | 0.798 | 0.266 |
| **Mother's Education** | | | | | | |
| **Primary** | 11 (6.1) | 13 (7.9) | 3 (5.0) | 05 (6.2) | 8 (5.7) | 0 (0) |
| **Secondary** | 38 (21.1) | 33 (20.1) | 11 (18.3) | 16 (20) | 28 (20.0) | 3 (21.4) |
| **University** | 131 (72.8) | 118 (72.0) | 46 (76.7) | 59 (73.8) | 104 (74.3) | 11 (78.6) |
| **P value** | 0.334 | 0.237 | 0.480 | 0.761 | 0.234 | 0.552 |

*Statistically significant at $P \leq 0.05$.
Chi-square test is used to compare study subgroups

## DISCUSSION

This study was set out to measure and compare OHBs of dental graduates according to their socio-demographic characteristics. The regression analysis showed that OHBs of dental graduates appeared to vary by their gender and whether they were graduated from a private or a state-run dental school. These findings accord with previous reports that showed variations on oral health attitudes and practices of dental students and support our assumption that professional dental education is insufficient to alleviate social and demographic variations in OHBs of dental practitioners and supports the notion that oral health knowledge does not always translate into positive behaviors. [3, 12] Dentists have a critical role in promoting oral health as well as boosting general healthy behaviors by delivering an effective oral health advice[13, 14] and act as role models for their families and societies. Therefore, there is a need for effective interventions to promote favorable oral health behaviors among dental students. Our study showed that Private-school graduates were more likely to consume sugary foods and drinks between meals than their peers from a state-run school. There are some possible explanations for this observation. The analysis of sociodemographic characteristics of study participants showed that private school students were more likely from higher income and social class, and this could through two strands of explanations. First, it could be the case that sugary products are more affordable to private school graduates than their peers from lower income families. Second, the higher consumption of sugary products in the private dental school can be seen as a reflection of environmental factors related to family or peers influence, which have a direct impact on eating patterns.[15] In other words, eating sugary products is part of the social activities of these groups or deeply rooted in their social norms after being adopted during childhood and carried out to adult life.[16, 17] Pervious research showed that parents' dietary pattern as well as food availability plays a major role in molding habits during childhood.[18] This explanation is supported by life course theories which suggest that health-related habits and outcome of health in adult life are the result of either accumulative or long lasting effects of early life course which put people on the trajectories of either health or disease.[19] Yet, additional qualitative research is required to fully explore and understand the environmental and social determinants of sugar consumption among Libyan dental students.

Female dental graduates were found, in this study, to be more positive in terms of brushing their teeth than their male peers. Although such difference was not significant, using fluoridated toothpaste, which indicates more sophisticated oral hygiene, was significantly more practiced by female students. Likewise, female students reported more frequent visits to the dentist than males. These findings came as no surprise since they were consistent with other studies among Libyan dentists and graduates in which females were found to be of more interest towards practicing preventive dentistry.[20, 21] The same results were observed in several studies that showed a higher gender-specific difference in favor of females in terms of practice of healthy habits.[22-24] Such differences could be attributed to the different physiological and psychological attitude in achieving an aesthetic appearance, which is largely imparted by healthy teeth and gums.

This study, to the authors' best knowledge, was the first to assess OHBs of dental graduates in Libya. It indicates that emerging dental work force in Libya may not be well prepared to fulfill their role as exemplars to their patients and the public. In this study only 70% of participants reported irregular use of dental floss and around 40% reported exceeding the optimum intake of sugars, which go in line with previous studies among dentists showing imperfect OHBs among dentists. For instance, in a study of USA dental practitioners, 56%, male dentists indicated flossing once a day at minimum.[25] In another study in Mongolia, 52% of dentists reported eating sugary snacks less than daily and 62% using fluoride toothpaste regularly.[8] However, further research in the form of content analysis of preventive dentistry curriculum and qualitative interviewing of dental student is needed to fully understand why they may not comply with oral health maintenance practices.

Although our study is preliminary and based upon cross-sectional design with self- reported data, which have their own inherent weaknesses, it has important implication when designing and planning behavioral interventions or preventive programs since it confirms the importance of accounting for family and environmental determinants of OHB, rather than relying only on changing knowledge and attitude.[10] It also highlights the need to put more emphasis in dental

curriculum on the need of tailoring health advice to patients' individual and social circumstance.

**Conclusion:** Although professionally educated, OHBs of dental graduates seem to vary by their socio-demographic characteristics, namely gender and type of school. While this may suggest a greater influence from environmental and socio-economic factors which should be considered when planning and designing interventions to promote oral health, dentists' oral health behaviors and their role in empowering the public need to be emphasized in dental curriculum.

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*Original article*

# Styloid Process Elongation, Shape and Calcification Pattern According to Age and Gender

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## ABSTRACT

**Background**: Styloid process (SP) is a slender pointed part of the temporal bone, which is closely related to the stylomastoid foramen. As many important neurovascular structures located near the tip of SP, the elongation or ossification of stylohyoid ligament may be associated with pain related to orofacial region known as Eagle's syndrome.

**Aim** of this study was to assess the prevalence of elongated SP, its morphology and calcification pattern on digital panoramic radiographs in patients attending the dental clinic of the University of Benghazi.

**Material and Methods**: The digital panoramic radiographs with visible styloid processes of the studied group of patients were studied for their visibility, length and pattern of calcification. The length of styloid processes was measured in the radiograph and was considered elongated if that length exceeded 30 mm. The prevalence and pattern of elongation and calcification were determined according to Langlais classification.

**Results:** Out of the 304 patients (164 are males and 140 are females) examined radiographically, the elongation of SP was detected in 156 (51.31%) of the patients. It was bilateral in 151 (96.79%) cases. There were no significant differences between males and females in regard to the length and shape of SP between in all age groups in both sexes, but the calcification pattern was significantly different between the age groups in both sexes. The outlined pattern of calcification of SP was the most prevalent especially in the younger age group (10-19 years), while the complete calcification pattern was most commonly detected in the older age group (≥ 60 years).

**Conclusion:** elongated SP whether it is accompanied by pain symptoms or asymptomatic, can easily be detected on a digital panoramic radiograph and should be considered in the differential diagnosis of orofacial pain.

**Keywords:** Styloid Process, Elongation, Calcification Pattern, Libyan patients.

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## INTRODUCTION

Styloid process is derived from the Greek word 'Stylos' which means a pillar. It is a long osseous projection of petrous part of the temporal bone in front of stylomastoid foramen projecting from it forward, downward and slightly medial. Styloid apparatus is a functional unit composed of three muscles (styloglossus, stylohyoid and stylopharyngeus) and two ligaments (stylohyoid and stylomandibular) all attached to it. [1.] The normal length of SP is 25 to 30 mm in adults [2.] It considered elongated if it exceeds 30 mm [3.]. The tip of the process is situated lateral to the pharyngeal wall and immediately behind the tonsil fossa, and critically between the internal and external carotid arteries. Medially many important neurovascular structures are located in close proximity to this tip such as internal jugular vein and accessory,

hypoglossal, glossopharyngeal, and vagus nerves. [4-6].

A wide variety of clinical symptoms have been attributed to the extraordinarily elongated styloid process, including unpleasant sensation in the throat similar to cervicofacial pain, described as by "Watt Eagle". [7,8]. Multiple theories have been proposed the ossification of the stylohyoid "Eagle's syndrome" such as trauma activating the remnants of fibrocartilaginous cells or an abnormal healing following trauma that initiates calcification of the ligament [9].

Although the exact etiology of SP elongation and ossification are still unknown, it is thought to be due to persistence of cartilaginous precursor [10,11] or due to systemic conditions altering calcium, phosphorus and vitamin D metabolism such as secondary hyperparathyroidism. The elongation of SP is diagnosed by both physical examination and radiological. Ortho Panoramic Radiograph (OPG) is the most widely used radiograph to determine SP elongation, while other projections such as the lateral skull, Towne's, lateral-oblique and anteroposterior head radiographs and computed tomography are also used as well. [12]. Clinically, SP palpation in the tonsillar fossa (which is not normally palpable) is indicative of elongation. Palpation exacerbating pain symptoms which can be relieved by local anesthetic injection into the tonsillar fossa is considered diagnostic.

Langlais et al had proposed classification system for of the elongated SP pattern and its ossification based on the radiographic appearance of stylohyoid ligament depending upon the morphology of elongation. type I represent an elongated SP which is uninterrupted; while type II, is a pseudoarticulated where styloid process joined to the stylohyoid ligament by single pseudoarticulation; type III is segmented (Figure 1) depending on the pattern of calcification as: calcified outline, partially calcified, nodular, or completely calcified [13].

## MATERIALS AND METHODS

In this retrospective, cross sectional study measurements of SP length, calcification pattern and shape were done on archived panoramic radiographic images of routine patients who had visited the dental clinic at Benghazi University dental clinic during the years 2009-2010. The study was conducted according to the human ethics guidelines set by this institution, in which an OPG was only taken for diagnostic purposes and needs.

A total of 304 digital panoramic radiographs were selected for this study. The radiographs taken by Vatech PaX-i Panoramic X Ray machine under standard exposure factors as recommended by the manufacturer. Only diagnostically acceptable images were included in the study.

SP Type and Pattern of Calcification of both the left and right side were analyzed independently and the length was measured using the IC software. The start point of measurement of the length of Sp was initiated was the base of temporal bone and downward to the tip of the process. An SP measuring more than 30 mm were considered as elongated. The ossified stylohyoid ligament that joined to SP was included of the measurements.

Data regarding all 304 panoramic radiographs were analyzed using IBM SPSS 23.0 (statistical package for social science Inc. Chicago, USA) software. Student t-test, One-way ANOVA, Chi-square and Fisher`s exact tests were used for statistical analysis. P values less than 0.05 was accepted as statistically significant.

## RESULTS

There was no statistically significant difference between the number of patients with elongated SP when they were subdivided into age groups. SP was elongated in 156 patients (80 males and 67 females). In 151 patients the elongation was bilateral representing (96.79 %) of the cases with an elongated SP. This difference between the sexes is not statistically significant. Similarly there was no significant difference between the two genders in the SP length. The mean length of styloid process was (42.43 ± 10.87) on the right side and (42.41 ± 10.89) on the left side. There is no significant difference between males and females regarding the mean process length or the shape or calcification pattern (Table 1) while the partial calcification pattern was the most common calcification pattern observed in both sides (Tables 2 & 3).

According to age groups, there is no statistically significant differences in the mean length of right and left styloid processes (p-value: 0.73 and 0.51 respectively). However in the age group (40-49 years) the left styloid process was significantly longer in females (51.60 ± 17.38 *vs* 37.94 ± 7.75, p-value=0.02), while in the age group (50-59 years), the left styloid was

significantly longer in males (31.57 ± 2.5 *vs* 38.46 ± 11.23, p value = 0.03). There was no significant differences in the morphology of the elongated styloid processes between the age groups of both genders.

## DISCUSSION

Elongation of styloid process and ossification of stylohyoid ligament has been reported by many investigators, the majority of individuals exhibiting this anatomical anomaly experience no symptoms. There is no agreed pathogenesis of this condition. The occurrence of styloid process elongation varies greatly in different populations. In the present study the prevalence of SP elongation is detected in more than half of the patients, all of them were asymptomatic, while other studies reported wide range of prevalence between 3.7 to 93%. [14-19.], this figure may had been resulted from differences in population or due to genetic factor.

It has been estimated that 4% of the general population have radiographic evidence of an elongated SP, the majority are asymptomatic, out of these only 4%-10.3% of the patients are having symptoms [28]. Elongation of SP appears bilaterally in most of the cases, even so the symptoms generally presents with unilateral orofacial pain [29.]

In the present study the percentage of SP elongation was almost the same in both genders in consistent with some other studies [20,21], and contradicting the findings of other studies [22,23]. Although elongated styloid process is noticed more in females than males in both sides there was no significant difference between age groups, while other studies reported significant relationship between age and elongation [24.]

Bilateral elongation is the norm in this study and was seen in almost all the cases which is in consistent with most of other studies, that reported a bilaterally elongation of SP [25,26] and showed an increased length of the styloid process with the increased age [23,26,27.]

According to Langlais classification, more than 72 % of the elongated SP in this study was type I elongation, while type II and type III elongation wee less frequently encountered in all age groups. However when it comes to the calcification pattern there was significant difference between all age groups in both sexes; as the outline calcification pattern being the most predominant pattern in the younger age group, while the complete calcification pattern was the most common pattern in older age group in consistence with other studies which found that the type I elongation pattern and the outline calcification pattern were the common [24.]

SP's clinical symptoms are not only related to elongation alone, but also related to the medial inclination of SP and its proximity to the neurovascular structures. This may explain the lack of symptoms in the majority of cases with an elongated SP in this study. However, Eagle' syndrome should always be considered in the differential diagnosis of head and neck pain such as facial neuralgias such as glossopharyngeal neuralgia, tonsillitis, dental infections and TMJ disorders.

The precise cause of SP elongation and ossification of stylohyoid ligament is not fully understood, however many theories have been proposed to explain that. Eagle considered the scar formation followed tonsillectomy or local chronic irritation could cause periostitis, osteitis or tendonitis leading to this syndrome [7.]

Panoramic radiographs have been commonly used until now by most of investigators to detect and study SP because it is economic, easily accessible and useful diagnostic aid for early detection of the elongated styloid process with or without symptoms, although CT is proved an effective means for evaluation of the SP length, angulation, and other morphological features [28]. However errors do occur by using panoramic radiographs which may lead to improper readings such as superimposition of SP with other skeletal structures, image magnification and angulation of SP.

**Conclusion:** Dentist should be aware of the styloid process elongation, which is often coincidental asymptomatic radiographic finding. OPG is still considered b man as an important tool for diagnosis of elongated styloid process. Further studies are still required to investigate the relationship between the type of styloid process and symptomatic presentation (Eagle's syndrome).

Table 1: SP calcification in different age groups

| Gender | Age | Calcification (Right side) | | | | P value | Calcification (Left side) | | | | P value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | | 1 | 2 | 3 | 4 | |
| Male | 10-19 | 66.6% | 0% | 0% | 33,3% | 0.004 | 66.7% | 0% | 0% | 33.3% | 0.028 |
| | 20-29 | 11.1% | 5.6% | 77.8% | 5,6% | | 11.1% | 5.6% | 77.8% | 5.6% | |
| | 30-39 | 42.1% | O% | 36.8% | 21.1% | | 42.1% | 0% | 38.9% | 21.1% | |
| | 40-49 | 40% | 6.7% | 26.7% | 26.7% | | 40% | 6.7% | 26.7% | 26.7% | |
| | 50-59 | 23.1% | 23.1% | 46.2% | 7.6% | | 23.1% | 23.1% | 46.2% | 7.7% | |
| | ≥60 | 0% | 0% | 100% | 0% | | 0% | 0% | 100% | 0% | |
| Female | 10-19 | 60% | 0% | 20% | 20% | 0.000 | 50% | 0% | 25% | 25% | 0.000 |
| | 20-29 | 40.9% | 13.6% | 0.9% | 36.4% | | 36.4% | 22.7% | 0% | 40.9% | |
| | 30-39 | 20% | 0% | 36% | 44% | | 20.8% | 0% | 45.8% | 33.3% | |
| | 40-49 | 0% | 20% | 80% | 0% | | 0% | 20% | 80% | 0% | |
| | 50-59 | 0% | 28.6% | 57.1% | 14.3% | | 0% | 28.6% | 57.1 | 14.3% | |
| | ≥ 60 | 0% | 22.2% | 66.7% | 11.1% | | 0% | 22.2% | 66.7% | 11.1% | |

Table 2: SP morphology in different age groups in both genders

| Gender | Age | Morphology (Right side) | | | P value | Morphology (Left side) | | | P value |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | | 1 | 2 | 3 | |
| Male | 10-19 | 50% | 16.66% | 33% | 0.07 | 50% | 16.66% | 33% | 0.25 |
| | 20-29 | 70% | 15% | 15% | | 65% | 10% | 25% | |
| | 30-39 | 56% | 12.5% | 31.25% | | 66.66% | 11.11% | 22.22% | |
| | 40-49 | 88.23% | 5.88% | 5.88% | | 77.5% | 6.25% | 6.255 | |
| | 50-59 | 92.3% | 7.7% | 0% | | 84.61% | 7.69% | 7.69% | |
| | ≥60 | 33.33% | 66.66% | 0% | | 33.33% | 66.66% | 0% | |
| Female | 10-19 | 60% | 20% | 20% | 0.52 | 33.33% | 16.66% | 50%5 | 0.52 |
| | 20-29 | 81.81% | 9.09% | 9.09% | | 71.42% | 9.52% | 19.04% | |
| | 30-39 | 72% | 12% | 16% | | 70.83% | 8.33% | 20.83% | |
| | 40-49 | 40% | 0% | 60% | | 40% | 0% | 60% | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50-59 | 66.66% | 16.66% | 16.66% | | 66.66% | 16.66% | 16.66% | |
| | ≥60 | 77.77% | 11.11% | 11.11% | | 77.77% | 11.11% | 11.11% | |

Table 3: Calcification pattern in both genders

| Right side | All | Male | Female | P value |
|---|---|---|---|---|
| Outline pattern | 25.2% | 27.1% | 23.3% | 0.27 |
| Nodular pattern | 8.4% | 5.7% | 11% | |
| Partial pattern | 41.3% | 47.1% | 35.6% | |
| Complete pattern | 25.2% | 20% | 30.1% | |
| | | | | |
| Left side | | | | |
| Outline pattern | 25.4% | 29.1% | 21.1% | 0.1 |
| Nodular pattern | 10.6% | 7% | 14.1% | |
| Partial pattern | 24.3% | 47.9% | 36.6% | |
| Complete pattern | 21.8% | 15.5% | 28.2% | |

Figure 1: TypeIII (Segmented) styloid process

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***Original article***

# Sharps and Needle-Stick Injuries among Students in Benghazi Dental faculty

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## ABSTRACT

Needle stick injuries (NSi) is occupational hazard of concern in medical community; as they pose a hidden threat of transmitting blood-borne infections such as HBV, HCV and HIV in the clinic.

**Aims** were to determine the current status of NSIs among dental students in Benghazi dental faculty.

**Methods**: 183 clinical years students were asked to complete a specifically designed questionnaire about their experience and opinions regarding NSi. Questions included incident reporting, sources of information and seriousness of NSi.

**Results**: Forty-five students (24.5%) had at least one NSi incident throughout their years of study in this faculty, more than (25%) of them had it more than once. About 80% of such incidents occurred in the first clinical year (3rd year BDS), particularly during injecting local anesthetic (18 students), when attempting to recap a needle (16 students), or when they were handling sharps (7 students). The student's knowledge about NSIs was principally gained from classroom lectures alone (155 students), or from other local advertizing media (15 students), or through instructions from clinical staff (13 students). Only Four students looked for further information from other sources such as scientific journals, textbooks, or libraries, (132) students are aware of clinic post exposure protocols, for 42 of them it was easy to understand and follow, 140 students think that an extra-precautions are necessary in dealing with patients of high risk, while 145 students believe that the needle stick injury is serious risk for infection transmission in clinic. **Conclusion**s: many factors such as availability of digital media, good classroom lecture coverage of NSi issue, and local educational events had raised the level of awareness among students about NSi in this faculty; nonetheless, NSi do occur in a considerable number of students. More efforts are needed to closely monitor new trainee students at their clinical sessions with a compulsory use of safety needles.

**Keywords** Needle Stick Injury, Dental Students, Libya, Clinical Study.

## INTRODUCTION

Needle stick injuries (NSi) and sharps injury are percutaneous piercing wound typically set by a needle point, but possibly also caused by other sharp instruments or objects that commonly encountered by people handling needles in the medical setting.[1] Eighty percent of blood contacts occur through needle sticks [2]

NSI is a well known occupational hazard in dentistry and medicine and their prevention has become a subject of regulations and amendments in an effort to reduce and eliminate this preventable event [3-5]. Despite their seriousness as a medical event, NSIs have been neglected or mostly unreported, while post-exposure protocols are not available in many cases. [6]

NSI may pose a risk for the patient if the injured health professional carries HBV, HCV or HIV. It had further been noticed that (37.6%) of Hepatitis B, (39%) of Hepatitis C and (4.4%) of HIV/AIDS in Health-Care Workers around the world are due to NSIs,[7] HBV in particular is the most common infectious disease transmitted through work-related exposure to blood o blood products. [2]

therefore, all patients should be considered as potentially high risk of infection and precautionary measures should be followed at all times. [8]

Previous studies proved that raising the knowledge of DHCW and students about NSIs can minimize the chances of transmission of infection to the working staff [9, 10,11]. The local post exposure infection control protocols should be assessed and updated periodically and their effectiveness in preventing cross infection are reassured. It is hoped that this study will shed light on the status of NSIs among dental students in Libya.

## MATERIAL AND METHODS

This cross sectional study was carried out in the dental faculty of Benghazi University, where a total of 183 students (in their clinical undergraduate years) had been interviewed at the end of the academic year to ensure that they gained enough clinical experience of dealing with sharps and needles, They have been asked to fill a specially constructed questionnaire which was designed to update information about the incidence of NSIs among dental students in this faculty, and their understanding of the clinic post exposure protocol, and the percentage of reporting such incidents to the authorized persons. The questionnaire included some questions regarding the student's sources of knowledge and their awareness about NSi problem and the risks of transmitting infection in the clinic b such injuries.

## RESULTS

Forty five students (24.5%) had NSIs during their clinical sessions, 80% of these incidents occurred when the student was at first clinical year ( 3rd year BDS), 60 % of these NSIs had never been reported to superiors.

About 25% of the students who had needle stick injury reported having more than one incident of NSIs. 18 students had a NSi while they were attempting to inject a local anesthetic, while 16 students injured during recapping of the needle and 7 of them had the injury while they were handling other sharps in the clinic. NSIs incidents were documented in only 13 cases of them.

Fortunately, all students in this group were vaccinated against HBV through the compulsory program of vaccinating all clinical dental health care workers (DHCW).

The main source of information for 155 students about NSIs was gained from classroom lectures, while 15 students get their knowledge from local written protocols and 13 from instructions from dental staff. [24] students looked for further information from other sources such as journals, books or local libraries after they became aware of the problem. 132 students are aware about the protocols of clinic post exposure and only 42 of them found these protocols easy to follow. 160 students believe that an extra-precautions are necessary when managing high risk patients and 145 students think that needle stick injury is serious risk for infection transmission.

## DISCUSSION

Needle stick injuries are common event in healthcare environment, mainly take place when drawing blood, administering an intramuscular or intravenous drug, or performing other procedures involving sharps. The needle can slip and injure the healthcare worker. This sets a platform to transmit viruses and other microorganisms from the source person to the recipient.[6, 12]

Many studies showed that most injuries commonly occur during needle recapping or as a result of failure to place the used needles in the approved sharps containers 13. During surgery, a surgical needle may inadvertently penetrate the glove and skin of the surgeon or assistant. Generally needle stick injuries cause only minor bleeding or visible trauma, however, even in the absence of bleeding the risk of viral infection remains high [14] Many authorities have long been adapting the use of syringes with safeguard mechanisms as standard to minimize accidents. [15]

According to WHO reports, out of the practicing 35 million health-care workers globally, about 2 million experience percutaneous exposure to infectious diseases each year.6 Most of these injuries occur during recapping the needle after use and disposal of used needle [16,17]. The frequency of NSIs has been estimated to be 600,000 to 800,000

cases annually in the USA alone.18 In China one study showed that about 77.1% of a hospital personnel had been experienced needle stick injury [17]. Another study from India similarly demonstrated high incidences of NSIs among interns and nurses 75.6% and 24.4%, respectively.19 the NSIs ranged between 55-57% in two studies from Uganda.[20,21]

Students in this study were chosen randomly to verify their opinions and practice in regard to NSIs. Current data demonstrated that as much as 79% of them are aware of the seriousness of NSIs and its risk of transmitting infection in medical field, this finding is in consistence with the findings of many studies from different parts of the world 19-20-21. Likewise, many previous studies involving dental students; show high awareness of students about NSIs (89.23% of the students had correct knowledge about NSi and 91.55% of the students had adequate level of awareness regarding its management in one study).[9]

Almost 76% of the students considered that an extra-precautions are necessary when managing high risk patients, but they are not sure about the measures to be considered if the NSi happened with them. This attitude depended largely on the source of information they had got until the moment of interview, as classroom lectures was the lonely source of information regarding NSIs.4 It seems that the education plays vital role in better effectiveness preventing cross infection in clinic, particularly, the full understanding of clinic postexposure protocols. Effective implementation of these protocols along with the use of most recent tools such as change to syringes with safeguard mechanisms coupled with appropriate training would decrease the chances of cross infection.[10]

Some studies claimed that the students with poor mark scores in their studies or those who are left handed were more prone to NSIs than others. 5,10 the same applies to healthcare workers, with better practice scores, had suffered fewer NSIs according to another study.[11]

Interestingly, a well planned clinic protocols are effective in this regard. The implementation of the EU Council directive 2010/32/EU, about elimination of NSIs in clinic has resulted in an almost 50% reduction in NSIs over 1 year.22 Another possible method of reducing the incidence of needle-stick injury is to use needles with safeguard mechanisms. [15]

Although the level of knowledge about the risk of cross-infection from NSIs was high among the interviewed students, there was decreased awareness on the means of prevention and protocol. Although there is a high degree of awareness about NSi among dental students attained from the ease of access to internet and local educational events, some incidents of NSI do occur especially among the newly introduced students which provoke the need for taking extra-precautionary measures and instruction.

The high prevalence of non-reporting of NSIs among students in this study actually reflects a worldwide problem, reported from different parts of the world. [4-5] Underreporting seemingly a worldwide problem as only (35.5%) reported any of their exposures in a study from Bosnia as well.12

The availability of educational media through the internet and local educational events has enormously raised the level of knowledge among the dental students in this faculty about infection control and particularly needle stick injury.

Conclusions needle stick injury is as common among dental students in this faculty as in other parts of the world, and despite the availability of post exposure protocols they are not fully implemented. More efforts are needed to address this problem properly at different levels according to the international standards through the improvement of the knowledge and awareness of the new dental trainee students, the use of syringes with safeguard mechanisms, as well as revising the way of reporting NSIs and monitoring the strict adherence to post exposure protocols.

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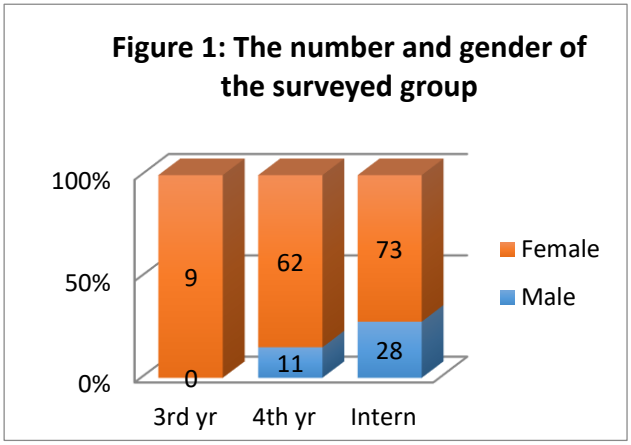
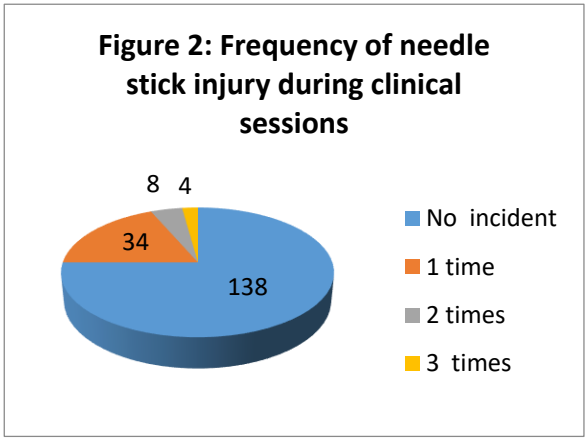
**Table 3: source of information about needle stick injuries**

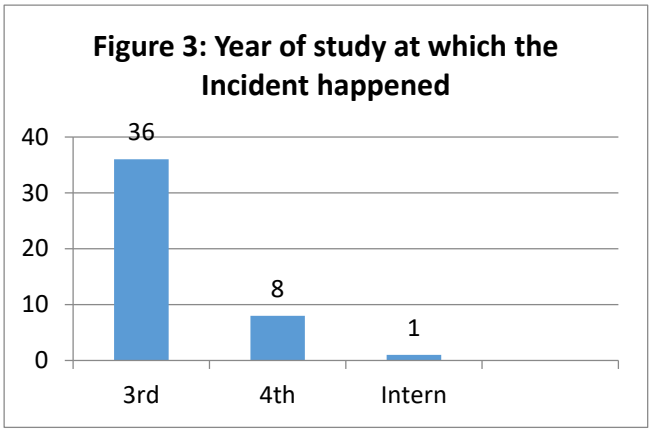
| Media | No. of students | Percent |
|---|---|---|
| 1. Classroom lectures | 155 | |
| 2. Continuous Medical education | 8 | |
| 3. Local written protocol and staff instructions | 25 | |
| 4. Books, leaflets and journals | 16 | |
| 5. Internet web sites | 13 | |
| 6. Told by a colleague or friend | 14 | |
| 7. Others | 4 | |

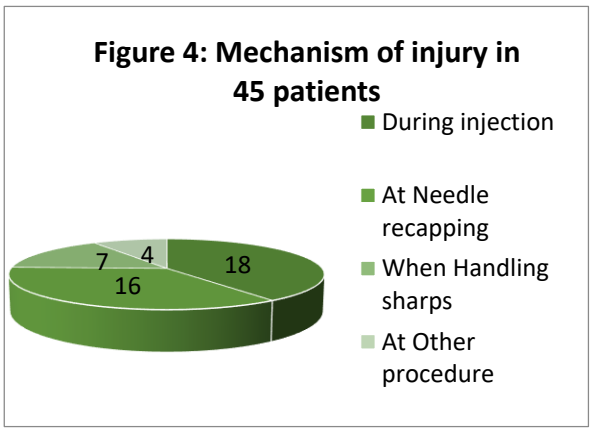
**Table 4: Accessibility to post exposure protocols**

| Subject | Yes | No | Don't know |
|---|---|---|---|
| 1. Are you aware of the clinic post-exposure protocols at your work area? | 132 | 51 | 0 |
| 2. Were the clinic post-exposure protocols easy to follow in the clinic? | 42 | 17 | 124 |
| 3. Do you think extra steps/precautions necessary when managing high risk patients? | 140 | 43 | 0 |
| 4. Do you think the risk of transmitting serious infectious disease via needle stick injuries is high? | 145 | 17 | 21 |



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