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Awareness and Practice towards Dental Iatrogenic Trauma:A cross-sectional survey among Dental Students in Maharashtra.

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ABSTRACT:Aim: The current study aimed at identifying the iatrogenic injuries most likely to occur in patients undergoing routine dental procedures along with identifying the most common nature of trauma and most affected site.
Materials and methods: A questionnaire based survey was conducted amongst the undergraduate dental students of dental coIIeges in the state of Maharashtra to assess the knowledge and attitude in this aspect. The questionnaire consisted of 13 close-ended questions and were circulated by mail, messages, WhatsApp, and Facebook using a google form link. The descriptive data in terms of percentage was analysed.
Results: Of the 1100 invitations sent 880 (80%) reverted back with the completely filled questionnaire. About 85% of the respondents had an accurate understanding of the term 'iatrogenic'. A majority of them identified mechanical damage to be more common nature of trauma and considered mucosa and gingiva to be the likely site damaged during dental treatment procedures. Most of them chose that iatrogenic errors were common during extraction and restorative-endodontic procedures. During Local Anaesthesia (LA) administration, piercing multiple times and injecting into blood vessel; crushing and tearing of gingiva in extraction procedures; post-operative sensitivity after scaling therapy; excessive preparation in doing tooth preparation and leaving high points in restorative procedure; denture induced stomatitis in prosthetic treatment and inappropriate behaviour management were voted most as common harm inflicted while providing dental care. Careful handling of materials and instruments was envisaged by most dental students to prevent iatrogenic trauma. Highly significant difference was found among the groups (P value < 0.001) for prevalence of knowledge and iatrogenic harm inflicted during tooth extraction and prosthetic procedures. Significant difference was also noted (P value = 0.013) for the most affected site, iatrogenic injuries during tooth preparation (P value = 0.004) and preventive approaches towards minimising iatrogenic incidences (P value = 0.029).
Conclusion:This study identifies most likely iatrogenic errors that can occur while carrying out routine dental procedures and highlights precautionary measures. With vigilant patient selection, diagnosis, treatment planning, monitoring, timely intervention, and good patient cooperation, any unwanted side effects can be avoided thus offering best form of dental care.
KEYWORDS:dental students, iatrogenic, harm, precautions, therapy

I. INTRODUCTION

Iatrogenesis is the causation of a disease, a harmful complication, or other ill effect by any medical activity, including diagnosis, intervention, error, or negligence (1). Iatrogenic injury refers to tissue or organ damage that is caused by necessary medical treatment, pharmacotherapy, or the application of medical devices and has nothing to do with the primary disease (2). Despite significant improvements in medical and surgical treatment quality, the frequency of iatrogenic injuries has been increasing in recent years. Patients may suffer serious physical and psychological suffering as a result of such injury, which may even result in medico-legal conflicts. Iatrogenic damage can be affected by a multitude of factors, including improper prescription, defective procedures, techniques, information, methods, or equipment, and carelessness. A dentist's practice, approach, or treatments in a dental environment can result in traumatic oral tissue lesions of iatrogenic origin(3).

Dental iatrogenic trauma can cause damage to the tooth, soft tissues, or both. Any dental therapy, at any stage, has the potential to be iatrogenic. There is always the potential of collateral damage to other oral and facial tissues when performing therapy in the mouth and face, especially when operating on supine patients. The oral environment is not just a limited region with limited access, but the nature of the dental tissues and the materials utilised to repair them necessitates sophisticated equipment that must function in close proximity to vulnerable soft

tissues. Iatrogenic factors include: overhanging of restorations, damage of tooth during preparation of adjacent class II cavity (G.V. Black's), injury to adjacent teeth during tooth extraction, jaw dislocation during tooth extraction, displacement of root in sinus during tooth extraction, laceration of gingiva during various dental procedures, overextension of removable prosthesis, loss of retention of removable prosthesis, exposure of pulp during cavity preparation and nerve injury during deposition of local anaesthesia (4-6).

The greatest way to assess the quality of training at any institution is to evaluate the students' perspectives (7). Students can give meaningful feedback that can be used to revise the curriculum and enhance the overall quality of training and patient care. (8). Wherever you go in the globe, there is usually a legal requirement in place that outlines the obligations of clinicians to guarantee adequate quality and safety standards in a dental office. It is nevertheless important to emphasise that it remains the responsibility of the clinician to ensure a patient is not inadvertently harmed, either by operator carelessness, failure of methods or equipment malfunction (9).

Dentistry is a rigorous curriculum that needs a considerable effort, encouragement, and practical experience. Competition, regular testing, comparison between students, teacher/student interactions, patient/student relationships, and clinical application of theoretical knowledge are some of the major stress factors that students may experience while being groomed as clinicians. As a result, dental students are more likely to make iatrogenic errors. Furthermore, the nature of the working space and the region adjacent to it contributes to the susceptibility. Face is one of the most complicated anatomical structures, including muscles, circulatory supply, collaterals, nerve supply, glands, sensory organs, lymphatics, sinuses, and other features. Also, not to forget the confined area in which working with a wide list of instruments is necessary, the most popular one going up to 4-8 lac rpm. Iatrogenic incidents by newcomers are unavoidable under these settings. (10-14). In the ever-changing scenario, one cannot afford to be negligent towards the same.

Experience is typically beneficial since it allows one to grow more comfortable coping with difficult situations during the working day. It is also important to remember that an experienced practitioner may grow complacent about the risks associated with dangers in a dental procedure. There is a need to enhance knowledge among dental students regarding the importance of iatrogenic influences in achieving a good outcome of any dental therapy, which will benefit not only the dental students in their future practices, but also the patients and society as a whole. To remind students of how easily things can go wrong, of what can go wrong, and of what each member of the dental team can do to prevent accidental injuries; and to ascertain the level of awareness, knowledge, practice and attitude, a survey was conducted amongst the clinical under-graduate dental students (3rd year and 4th year BDS) and interns.

II. MATERIALS AND METHODS

The present study is a self-reporting questionnaire based survey, conducted across dental colleges in the state of Maharashtra, India. In this study, a total of 1100 invitations were sent as per the following criteria.

Inclusion Criteria:

i) Undergraduate students undergoing clinical training and having treated patients on a daily basis- Third year BDS, Final year BDS and Interns.

Exclusion Criteria:

i) Students not willing to take part in the study.
ii) Students absent for more than 5 consecutive days from a particular clinical posting were omitted from this study.

A total of 880 undergraduate dental students responsible in rendering dental treatment to patients, voluntarily participated. Informed consent was obtained from all individual participants included in the study. Participants were evaluated by their response to the questionnaire. The age and gender factors were not considered in the present study. A 12-item questionnaire was created for this study to assess the awareness about the iatrogenic trauma and to identify the common ones inflicted while practising routine dental treatment procedures. The questionnaire was formulated in English language in a close-ended format. About 2-3 minutes were estimated to answer these 12 questions. The Google form was created and distributed via social media platform amongst the selected sample as explained above. Questions in this study covered the following areas: (i) knowledge and awareness (ii) clinical practise and (iii) attitude regarding iatrogenic injuries. Majority questions in the questionnaire were based on injuries inflicted during routine dental practice.

Once the completely filled questionnaire were obtained by all the participants, data was compiled on a MS Office Excel Sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States). All data were entered

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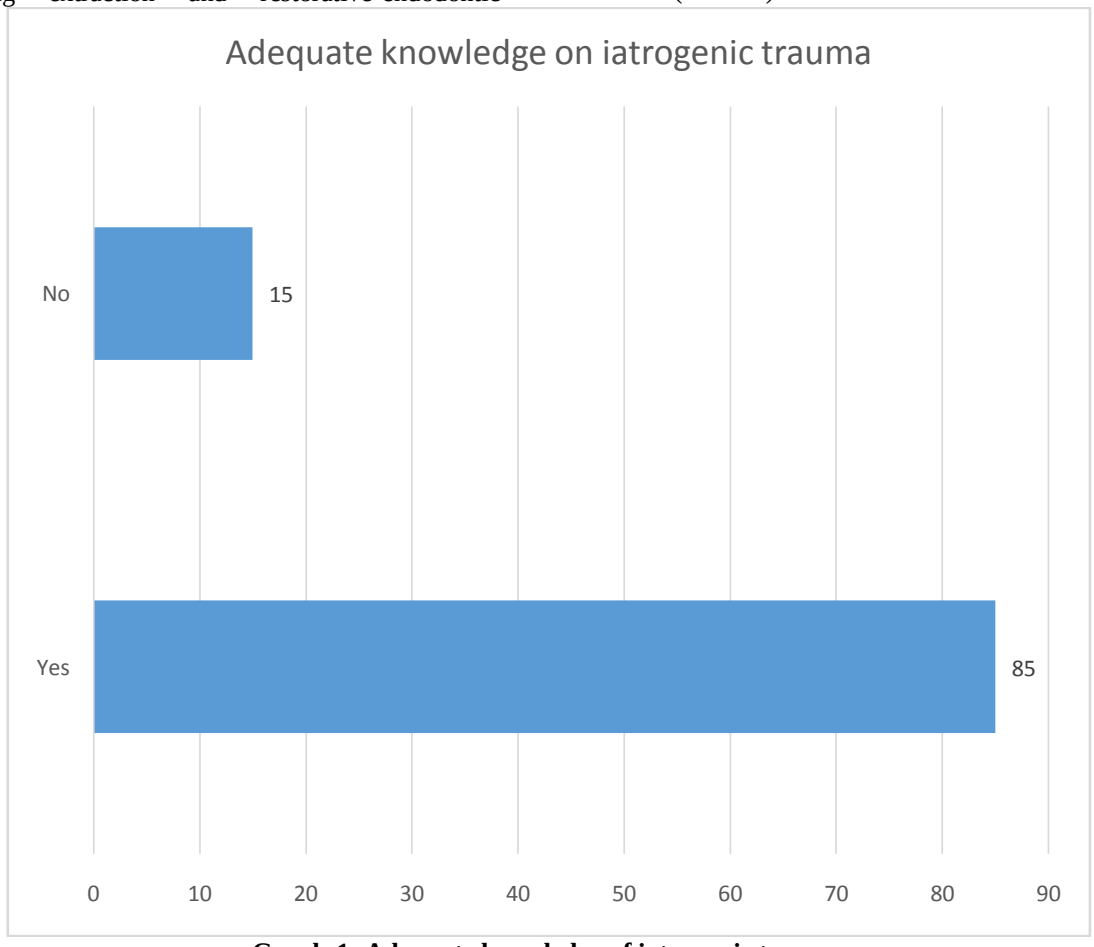
into a computer by giving coding system, proofed for entry errors. Data was subjected to statistical analysis using Statistical package for social sciences (SPSS v 24.0, IBM). Statistics used in the study were descriptive and inferential which included Pearson Chi-square test. For all the statistical tests, $p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

III. RESULTS

Of the 1100 invitations sent, 880 (80%) duly-completed responses were obtained. In this study 338 respondents were Interns, 309 respondents were final year BDS students and 233 were third year Bachelor of Dental Surgery (BDS) students.

A majority of them identified mechanical damage to be more common nature of trauma and considered mucosa and gingiva to be the likely site damaged during dental treatment procedures. Most of them chose that iatrogenic errors were common during extraction and restorative-endodontic procedures. During Local Anaesthesia (LA) administration, piercing multiple times and injecting into blood vessel; crushing and tearing of gingiva in extraction procedures; post-operative sensitivity after scaling therapy; excessive preparation in doing tooth preparation and leaving high points in restorative procedure; denture induced stomatitis in prosthetic treatment and inappropriate behaviour management were voted most as common harm inflicted while providing dental care. Careful handling of materials and instruments was envisaged by most dental students to prevent iatrogenic trauma. (Graphs 1-12)

Highly significant difference was found among the groups (P value < 0.001) for prevalence of knowledge and iatrogenic harm inflicted during tooth extraction and prosthetic procedures. Significant difference was also noted (P value = 0.013) for the most affected site, iatrogenic injuries during tooth preparation (P value = 0.004) and preventive approaches towards minimising iatrogenic incidences (P value = 0.029). Results are presented in percentage and tabular format below. (Table-1)



Graph-1: Adequate knowledge of iatrogenic trauma

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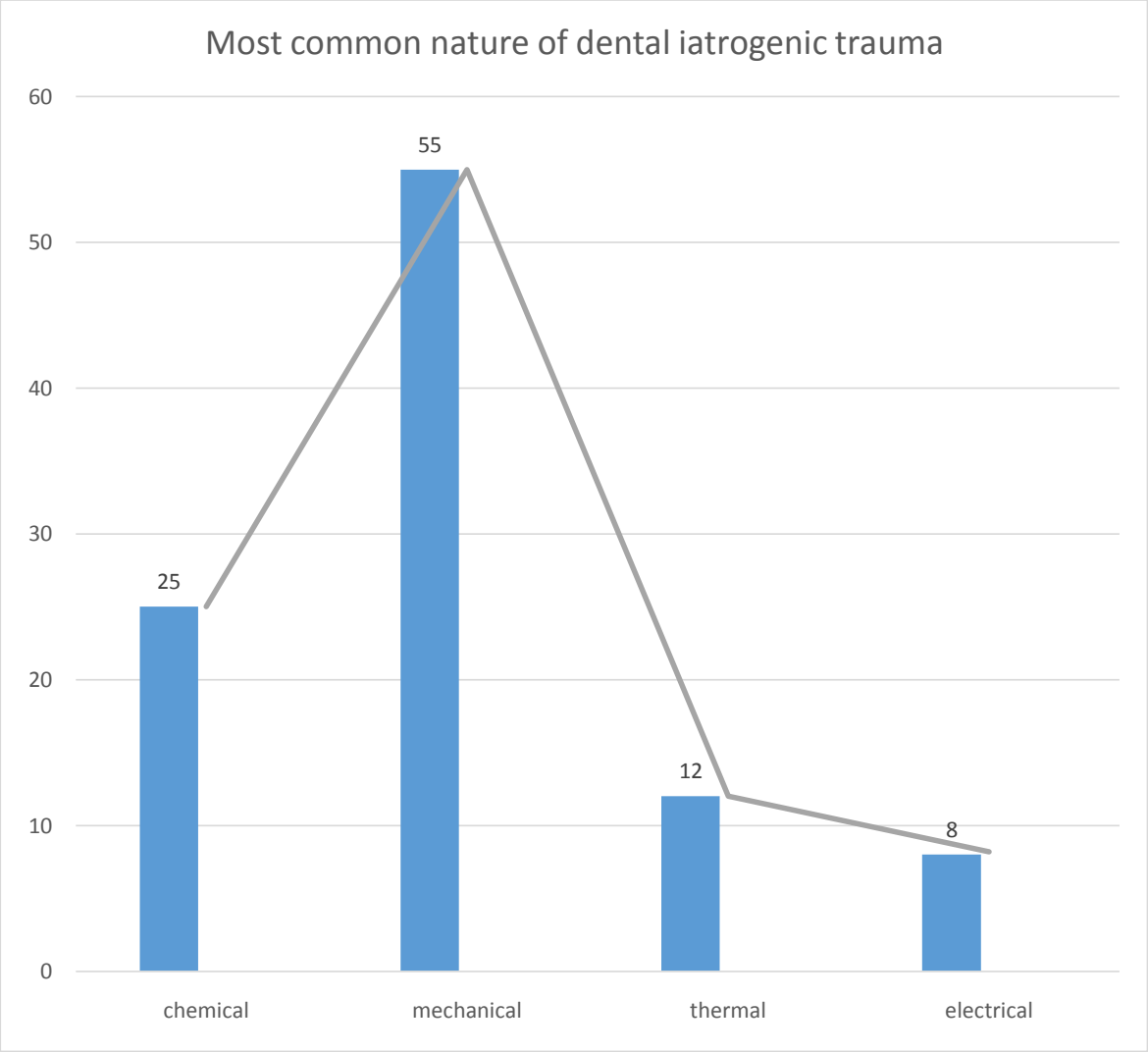

Graph-2: Most common nature of dental iatrogenic trauma

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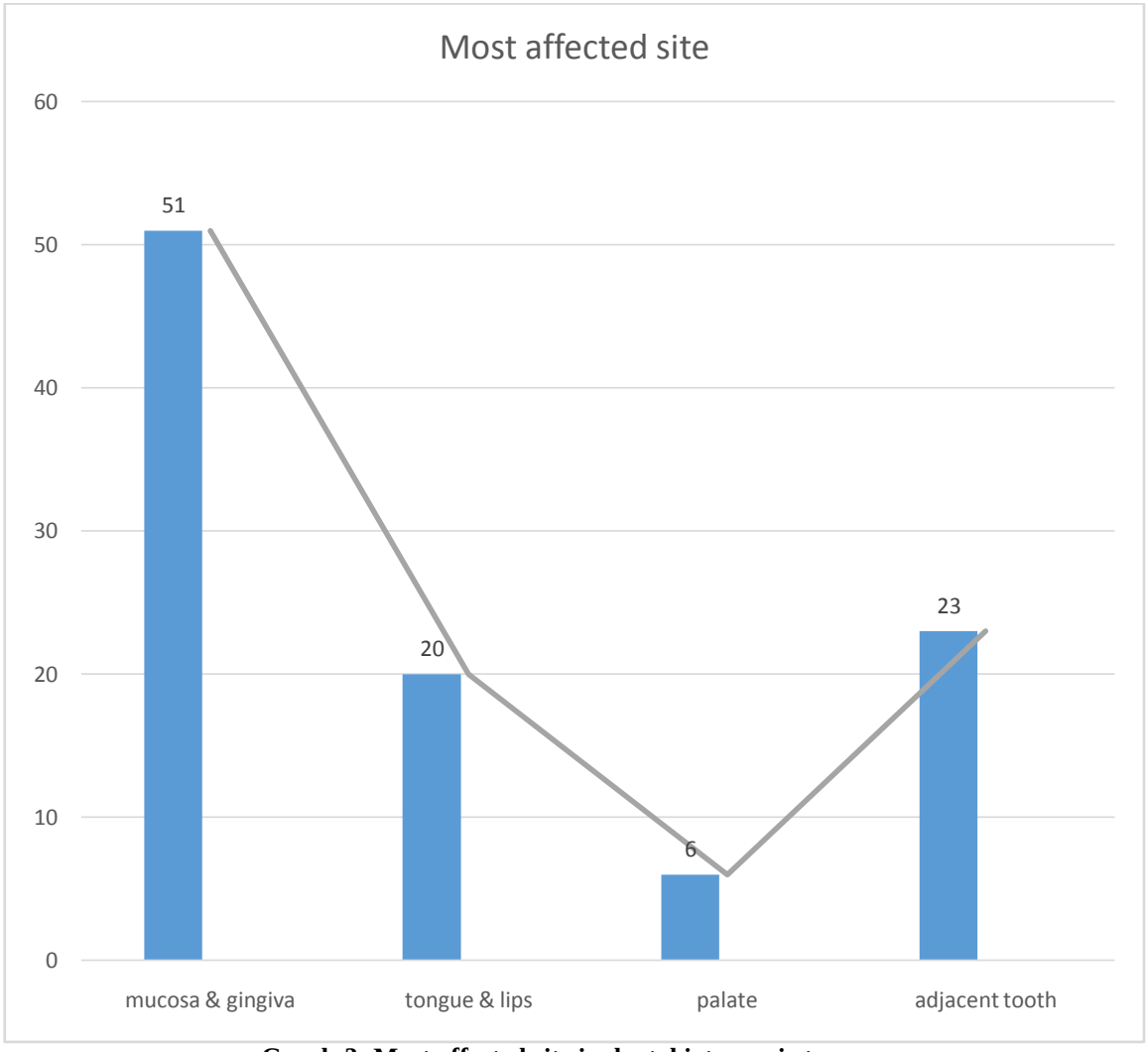
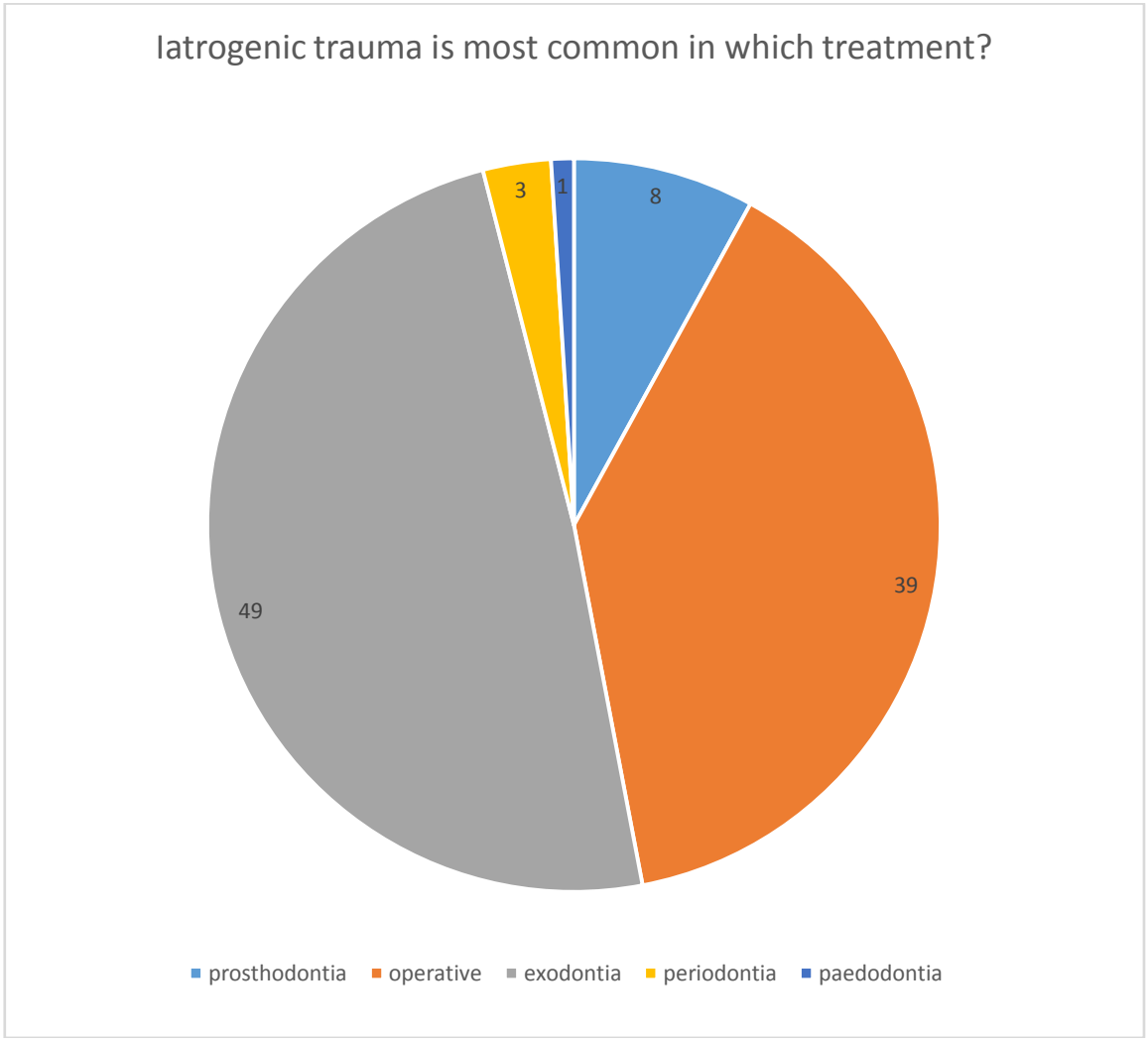


Graph-3: Most affected site in dental iatrogenic trauma



Graph-4: Most common procedure involving iatrogenic trauma

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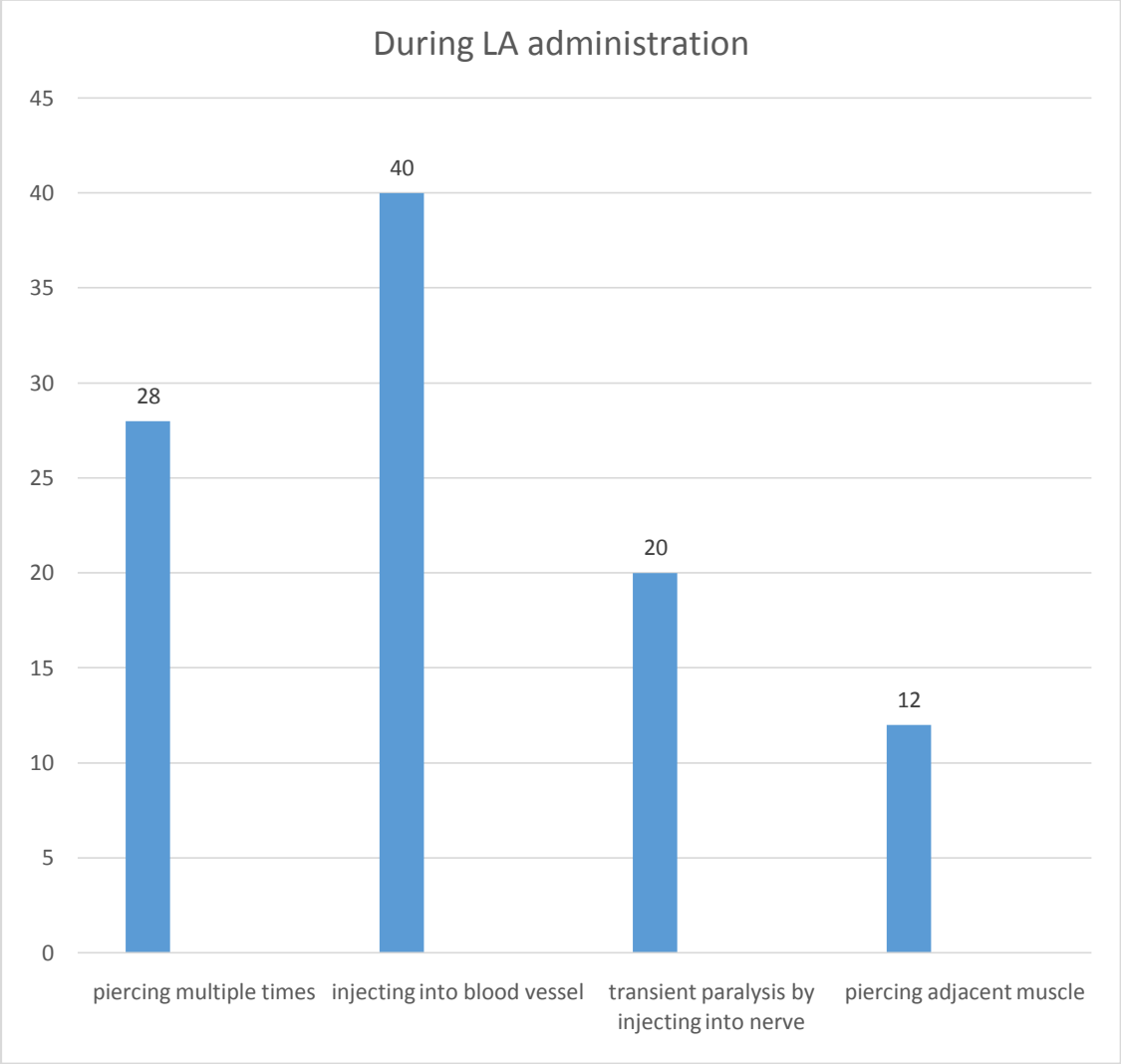

Graph-5: Iatrogenic trauma inflicted during local anaesthetic (LA) administration

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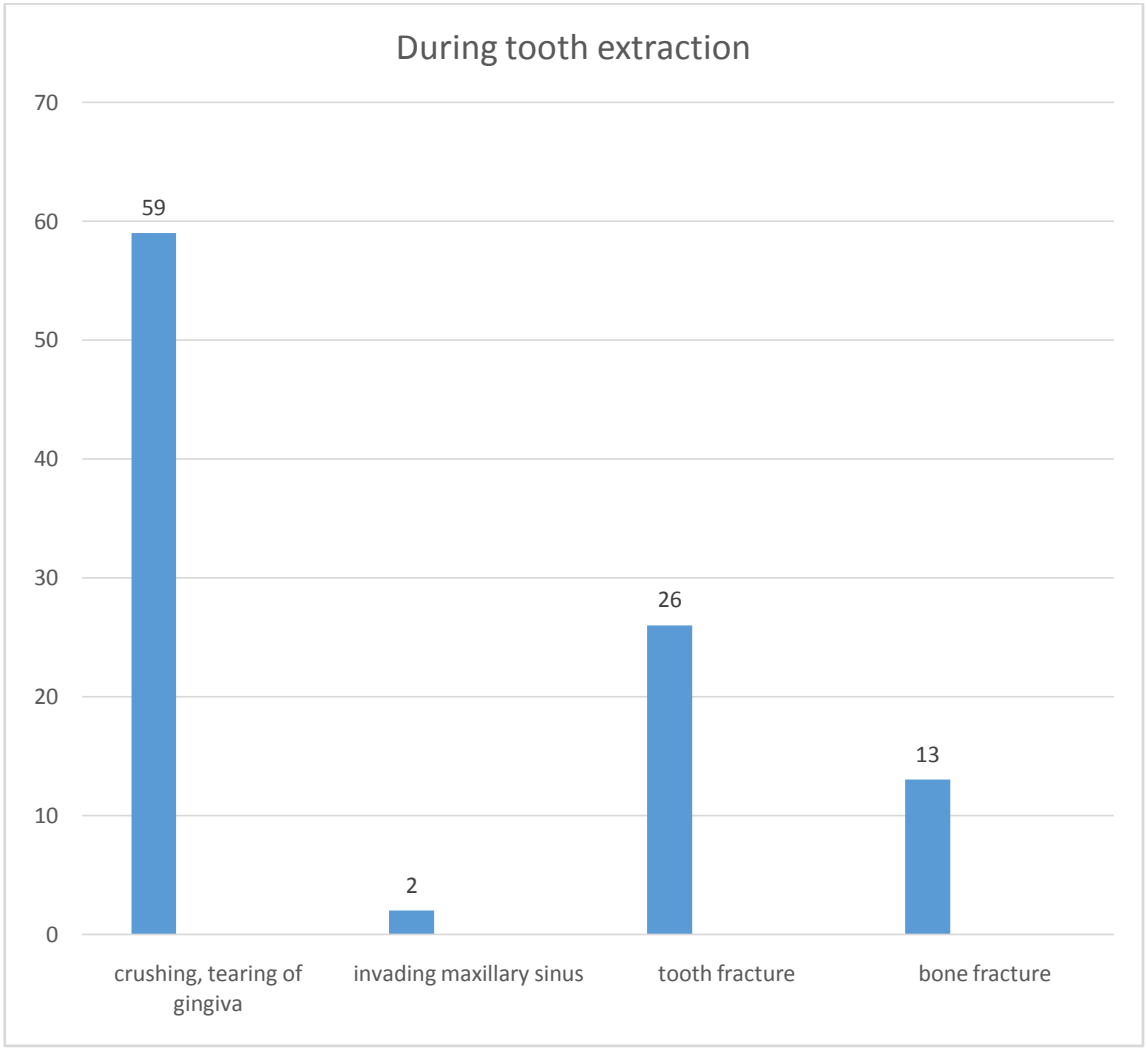

Graph-6: Iatrogenic trauma inflicted during tooth extraction procedure.

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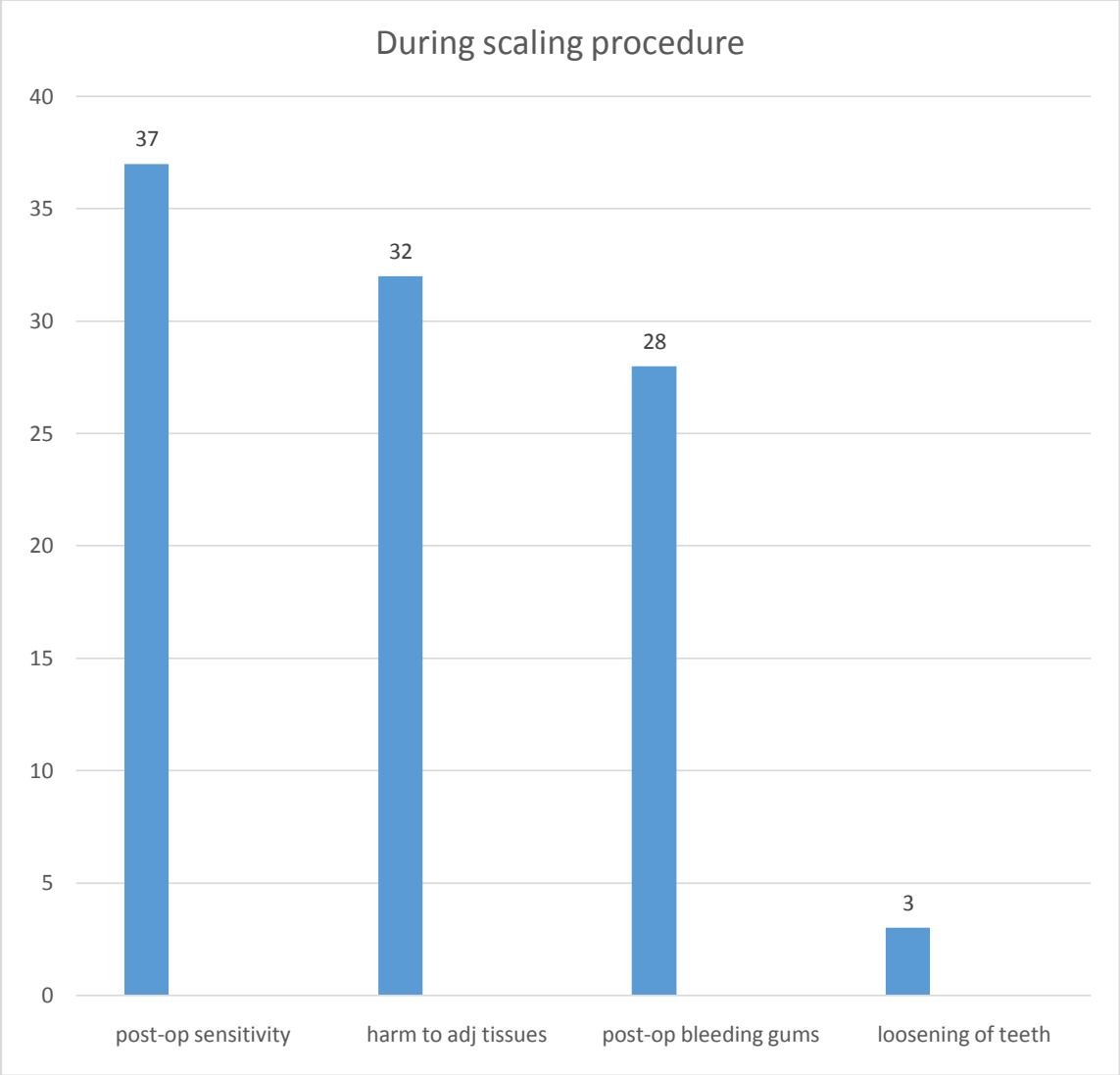
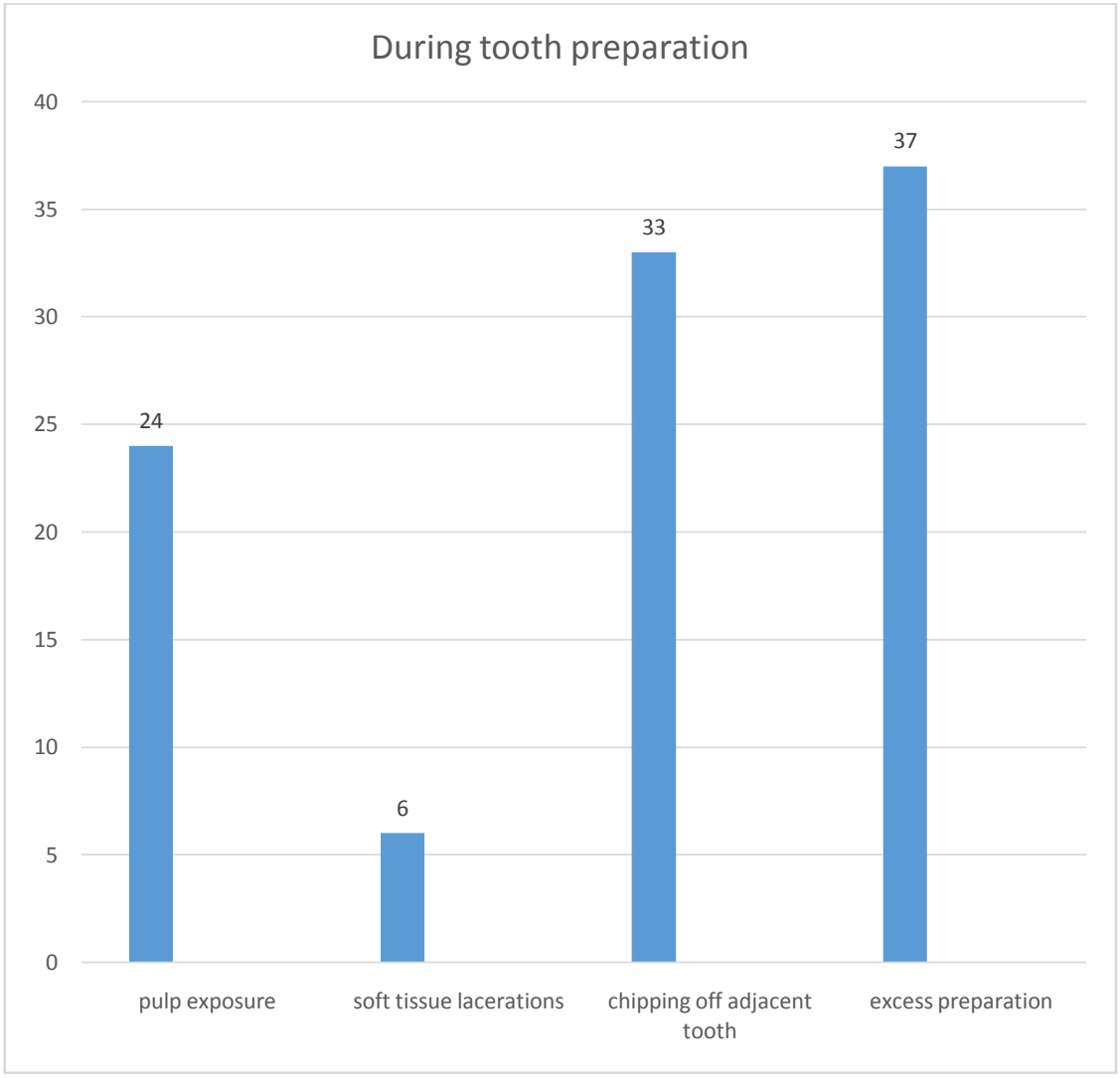
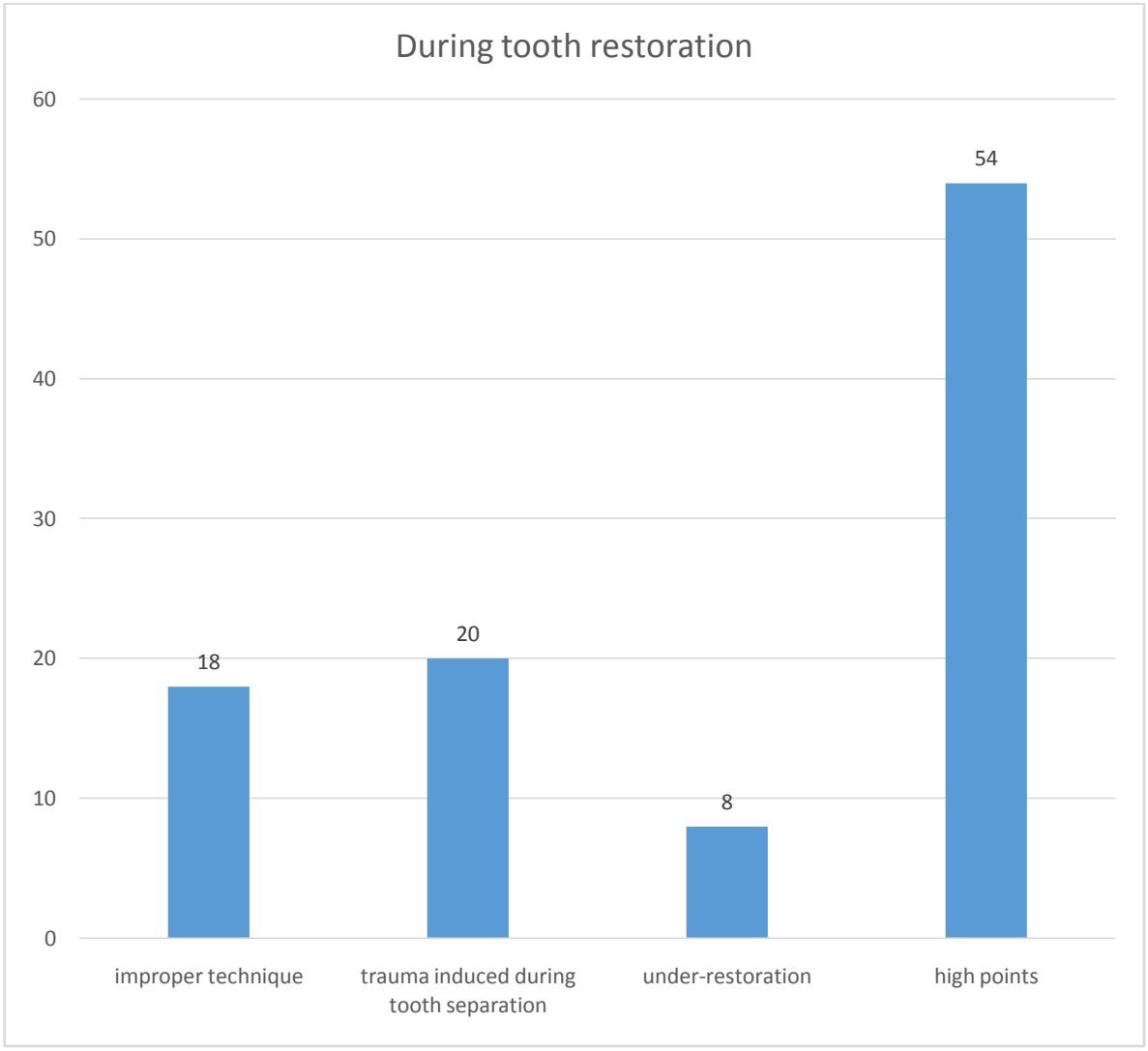


Graph-7: Iatrogenic trauma inflicted during scaling procedure



Graph-8: Iatrogenic trauma inflicted during tooth preparation.



Graph-9: Iatrogenic trauma inflicted during tooth restoration.

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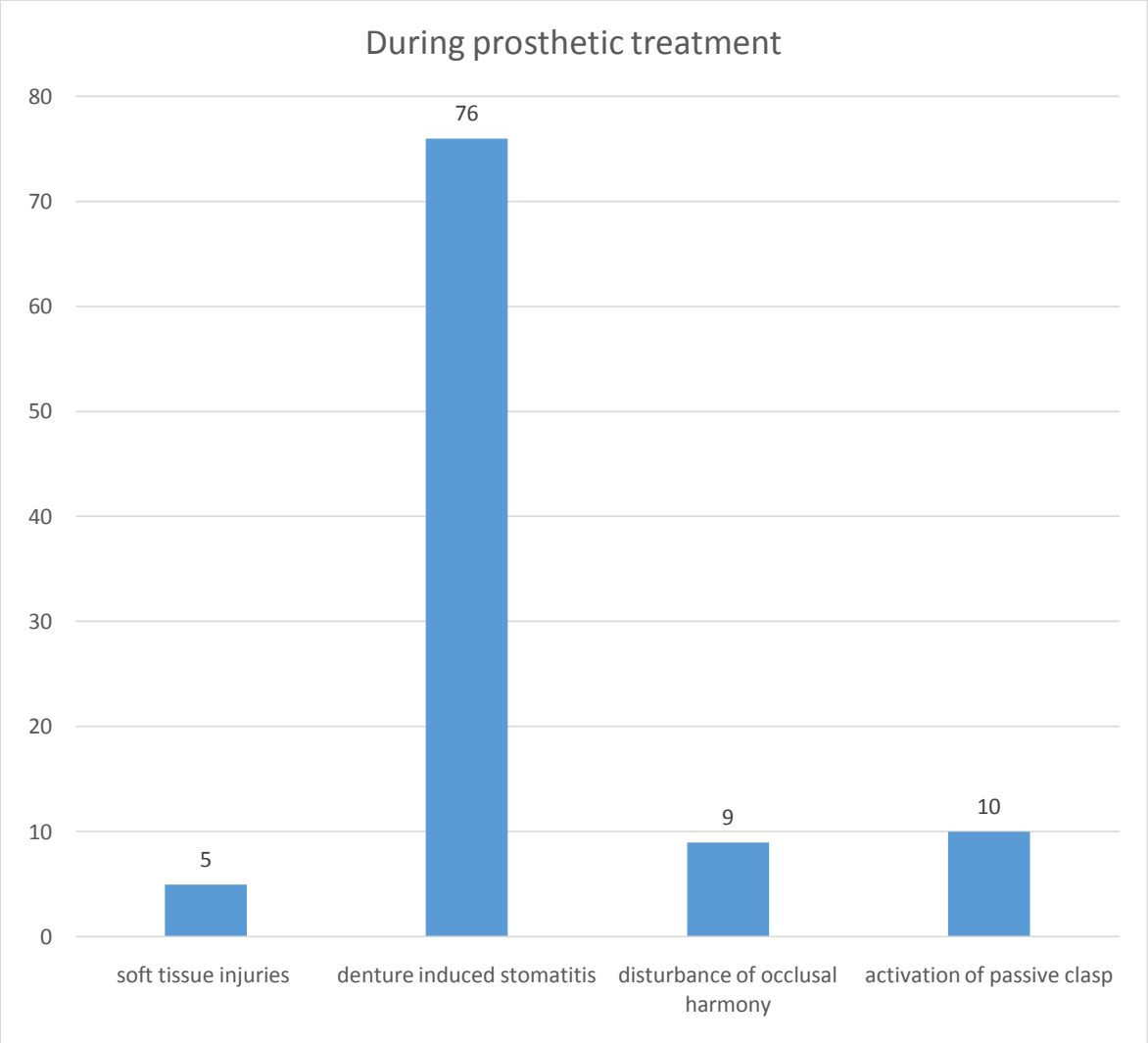
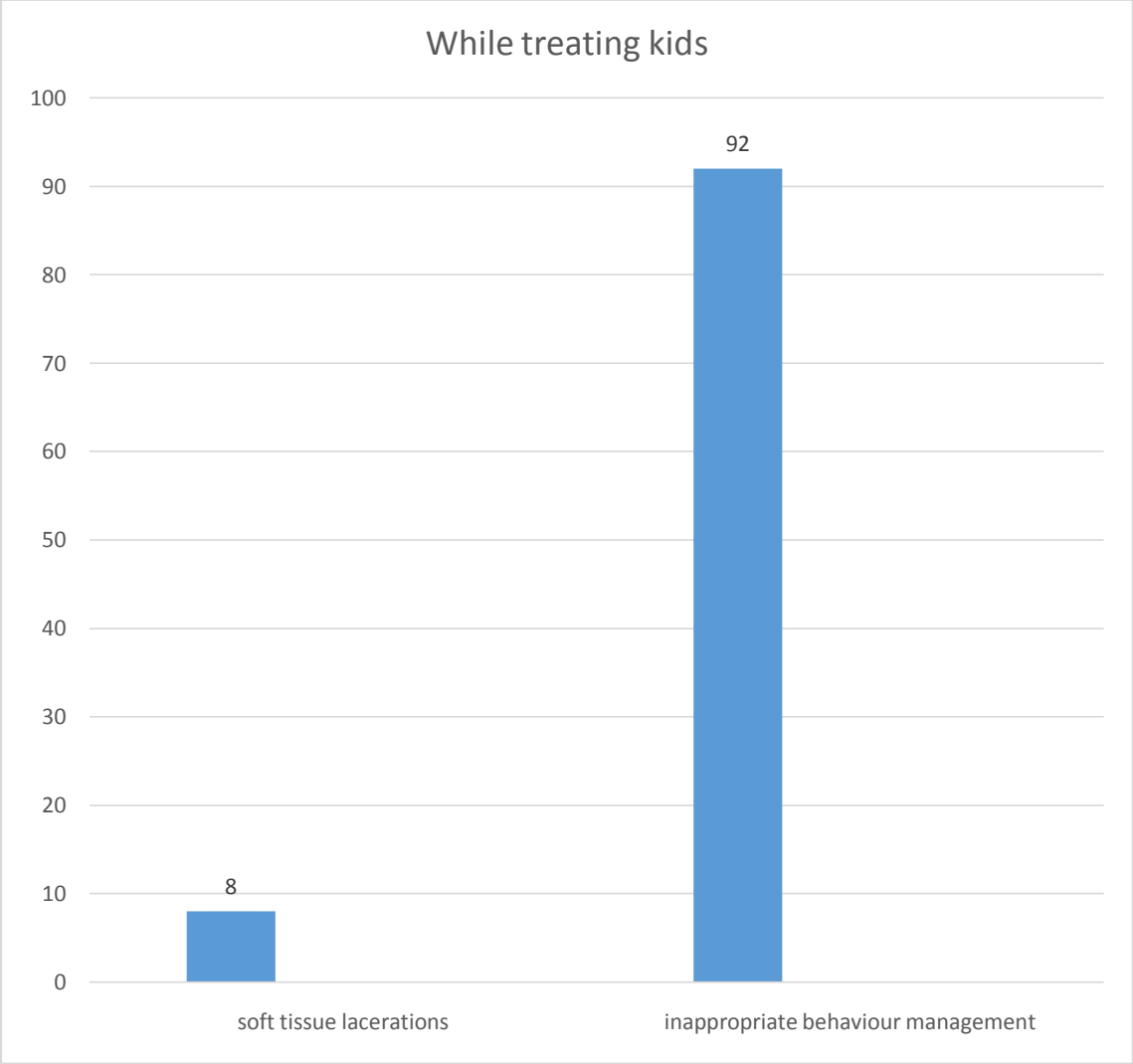
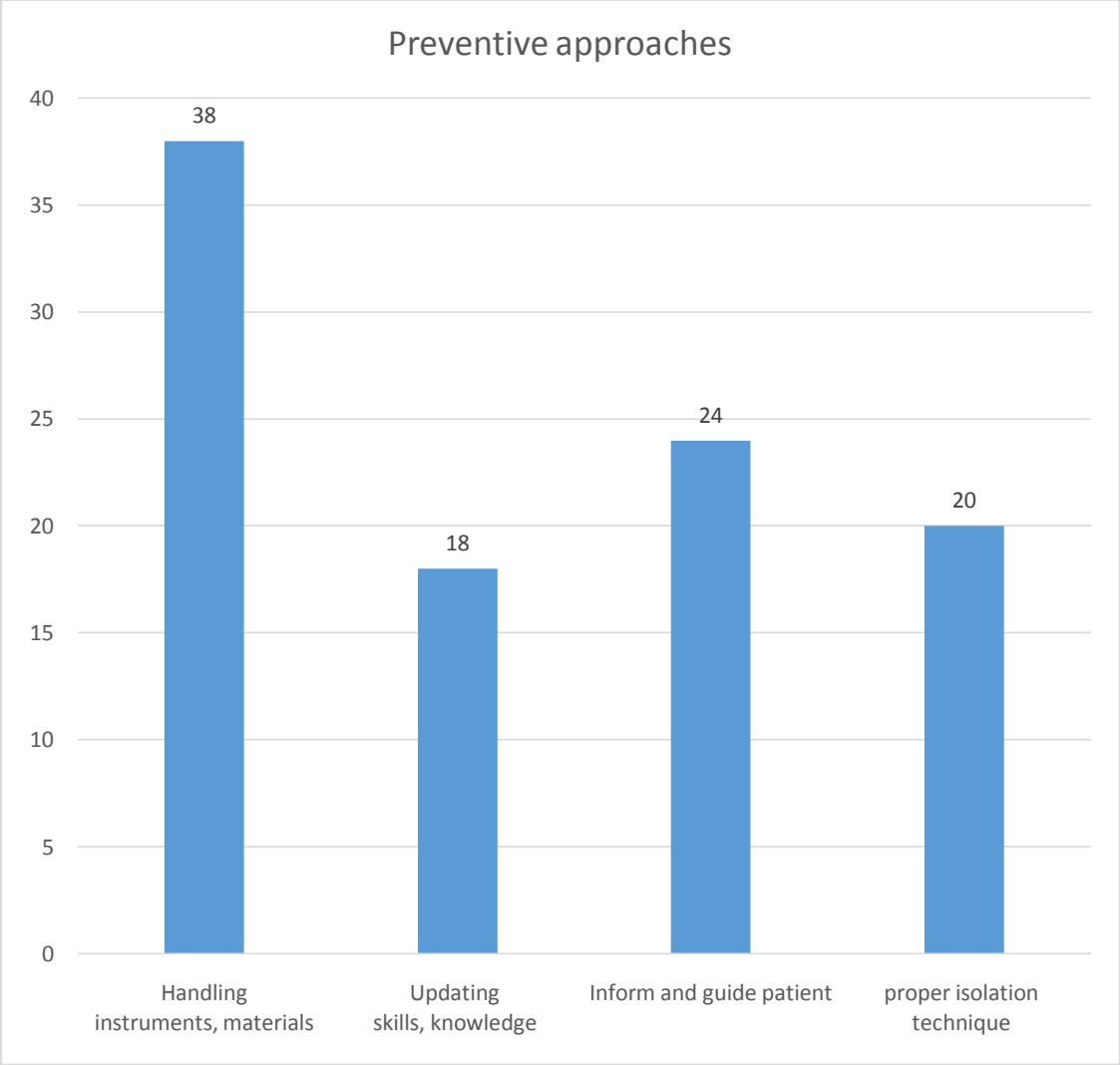


Graph-10: Iatrogenic trauma inflicted during prosthetic treatment.



Graph-11: Iatrogenic trauma inflicted while treating kids.



Graph-12: Preventive approaches for minimising dental iatrogenic incidences.

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QUESTIONS			YEAR OF STUDY			TOTAL	p value
			INTERNS	FINAL BDS	THIRD BDS		
Adequate knowledge on iatrogenic trauma	Yes	N %	330 98%	279 90%	139 60%	748 85%	< **.001****
	No	N %	8 2%	30 10%	94 40%	132 15%	
Most common nature of dental iatrogenic trauma	chemical	N %	84 25%	77 24%	59 20%	220 25%	0.547
	mechanical	N %	186 55%	170 54%	128 62%	484 55%	
	thermal	N %	40 12%	37 14%	29 11%	106 12%	
	electrical	N %	28 8%	25 8%	17 7%	70 8%	
Most affected site	mucosa and gingiva	N %	271 80%	124 40%	54 23%	449 51%	**0.013***
	tongue and lips	N %	17 5%	62 20%	97 42%	176 20%	
	palate	N %	0 0%	31 10%	22 9%	53 6%	
	adjacent tooth	N %	50 15%	92 30%	60 26%	202 23%	
Iatrogenic trauma is most common in which treatment?	prosthodontia	N %	26 8%	34 11%	0 0%	70 8%	0.054
	operative	N %	90 27%	105 34%	148 64%	343 39%	
	exodontia	N %	212 62%	155 50%	75 32%	431 40%	
	periodontia	N %	10 3%	16 5%	0 0%	26 3%	
	paedodontia	N %	0 0%	0 0%	10 4%	10 1%	
During LA administration	piercing multiple times	N %	83 25%	74 24%	89 38%	246 28%	0.096
	injecting into blood vessel	N %	115 34%	139 46%	98 42%	352 48%	
	transient paralysis by injecting into nerve	N %	100 30%	56 18%	20 9%	176 20%	
	piercing adjacent muscle	N %	40 11%	40 12%	26 11%	106 12%	
During tooth extraction	crushing, tearing of gingiva	N %	200 59%	182 60%	137 61%	519 59%	< **.001****
	invading maxillary sinus	N %	0 0%	8 2%	10 6%	18 2%	
	tooth fracture	N %	108 32%	100 32%	21 10%	229 26%	
	bone fracture	N %	30 9%	29 6%	55 23%	114 13%	

During scaling procedure	post-op sensitivity	N %	99 30%	157 50%	70 30%	326 37%	0.072
	harm to adjacent tissues	N %	136 40%	104 34%	42 18%	282 32%	
	post-op bleeding gums	N %	103 30%	48 16%	95 41%	246 28%	
	loosening of teeth	N %	0 0%	0 0%	26 11%	26 3%	
During tooth preparation	pulp exposure	N %	50 15%	61 20%	100 43%	211 24%	**0.004***
	soft tissue lacerations	N %	21 6%	11 4%	21 10%	53 6%	
	chipping off adjacent tooth	N %	110 32%	120 39%	60 25%	290 33%	
	excess preparation	N %	157 47%	117 37%	52 22%	326 37%	
During tooth restoration	improper technique	N %	48 14%	60 20%	50 21%	158 18%	0.491
	trauma induced during tooth separation	N %	72 21%	49 15%	55 24%	176 20%	
	under-restoration	N %	18 5%	52 16%	0 0%	70 8%	
	high points	N %	200 60%	148 49%	128 55%	476 54%	
During prosthetic treatment	soft tissue injuries	N %	0 0%	20 6%	24 10%	44 5%	**< .001****
	denture induced stomatitis	N %	272 80%	231 75%	166 70%	669 76%	
	disturbance of occlusal harmony	N %	26 8%	30 10%	23 11%	79 9%	
	activation of passive clasp	N %	40 12%	28 9%	20 9%	88 10%	
While treating kids	soft tissue lacerations	N %	20 6%	35 11%	15 6%	70 8%	0.363
	inappropriate behaviour management	N %	318 94%	274 89%	218 94%	810 92%	
Preventive approaches	handling instruments, materials	N %	121 36%	109 36%	105 45%	335 38%	**0.029***
	updating skills, knowledge	N %	24 7%	78 25%	56 24%	158 18%	
	inform and guide patient	N %	98 29%	70 23%	42 18%	211 24%	
	proper isolation technique	N %	94 28%	52 16%	30 13%	176 20%	

* = statistically significant difference ($p<0.05$)
** = statistically highly significant difference ($p<0.01$)
# = non significant difference ($p>0.05$)
Table-1: Awareness and Practice towards dental iatrogenic trauma in dental students

IV. DISCUSSION

"Iatrogenic" is derived from Greek Language where "Iatros" means Doctor/Healer "Gennan" means "as a Result" (5). The tradition of conservatism is central and of utmost importance in medical practice. This has grown up in the centuries since Hippocrates set forth the non-maleficence principle "Primum non nocere" i.e. first do no harm. Napoleon, when advised to consult his physician said, "I do not want two diseases - one nature-made, one doctor-made" (15). In context of dentistry, iatrogenic harm can be attributed to a plethora of reasons such as careless therapeutic procedures, injudicious use of instruments and chemicals, improper treatment planning and negligence (4).

Third year is the milestone in dental education when one is introduced to clinical training. It is this year, in which students get clinical exposure and commence treating patients. Well, in this anxiety and excitement, one tends to commit intentionally or unintentionally few iatrogenic incidences which may turn the treatment as a setback for the patient. Furthermore, face is considered one of the most complex anatomical structure. The soft tissues in the mouth which include the tongue, cheek mucosa, gums and lips are delicate, sensitive and easily prone to injury. Iatrogenic injury to the oral tissues, both hard and soft tissues during dental procedures practised as routine, may lead to severe pain, non-cooperation and further affect the quality of the healthcare. Special considerations must be taken in avoiding these injuries as they aid in determining the outcome of any treatment procedure. Hence this study was designed to identify the most common injuries which can be inflicted while performing routine dental procedures. This, in extension will help in planning out necessary precautions that can be taken to avoid any such mishap in the future.

AWARENESS:

It is vital to know about iatrogenesis first, in order to prevent any accidental pain or trauma to the patient and deliver the treatment as smoothly as possible. The study mainly focused on the iatrogenic injuries and out of the 880 respondents, 85% were aware about the term iatrogenic trauma while 15% of the dental students in the study lacked knowledge in this aspect. There was a considerably higher prevalence of knowledge among interns (Interns, 98% > Final BDS, 90% > Third BDS, 60%) than final and third year BDS students. This gap makes it imperative to provide with the students, adequate information on this domain. Most of the respondents felt that mechanical (55%) type of injuries occur most commonly followed by chemical (30%), thermal (12%) and electrical (3%). Mechanical injuries may occur due to improper handling of dental instruments and employing improper techniques in providing dental care. Chemical injuries in the oral cavity may readily occur owing to the large number of chemical substances, such as drugs and various dental materials, which come in contact with the oral cavity (16). Dental adhesives have been shown to be toxic to the gingival fibroblasts (17). Residual monomers may cause gingival irritation and inflammation (18). Phosphoric acid, used as an etching material and as a root surface modifier, has necrotizing effects on periodontal soft tissues (19). Moreover, thermal injury may occur during prosthetic impression recording procedures. Checking with the patient and observing for early signs of allergic reactions and any discomfort will aid in minimizing such incidents. Also the inventory of dental materials must be kept up-to-date, avoiding use of expired materials. The dental instruments must be in proper working conditions with desired cutting efficiency. The dental chair and associated electricals can be serviced on a regular basis to avoid any mishap.

PRACTICES:

The mucosa and gingiva are in close approximation to the tooth. Hence mucosa and gingiva (51%) the most affected site (Interns, 80% > Final BDS, 40% > Third BDS, 23%) for iatrogenic damage, bear the abuse. This is followed by injury to adjacent tooth (23%) during tooth preparation, tongue and lips (20%) and also the palate (6%). Iatrogenic injury can occur while administrating local anaesthesia, during extraction procedure, scaling, and chemical materials such as drugs and various agents which come in contact with oral cavity (16). The respondents said that iatrogenic injuries are most likely to occur during exodontia (48%) and endo-restorative (39%) procedures. Thus the counsel is to anticipate mistakes, prepare accordingly and be more vigilant while executing these procedures.

In the context of maximum dental procedures, local anesthesia numbs the mouth so that it becomes insensitive to many injuries. This can exacerbate the problem since the clinician

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is unaware of the damage being caused. As it is said- respect the tissues, for in turn, they respect you and your procedure. Thus, during invasive procedures, it is always advised to use a firm yet gentle hand.
In order to avoid inadvertently injecting soft tissue structures, such as major blood vessels, muscle attachments
when administering local anesthesia, the clinician must know their location.28% of the responses suggested trauma caused due to LA not acting in the first attempt and therefore piercing multiple timesand injecting the LA into the blood vessels (40%) were more common. Injuries can be caused to intra-oral tissues when sharp instruments may accidently slip during minor oral surgery or other procedures. According to the responders' (Interns, 59% < Final BDS, 60% < Third BDS, 61%) crush injuries (59%) most commonly arise during exodontia procedures, resulting from the accidental trapping of soft tissue in extraction forceps; followed by fracture of the tooth (26%). Fracture of the alveolar bone (13%) by applying undue force and not supporting the jaw bone. Judicious use of force while using extraction forceps, elevators and following scientific principles for flap reflection and extraction, elevation is the key to nullify such errors in practice. Scaling with hand instruments is not normally practiced in clinics, but students gain fine skills through this. The excessive pressure from clinician, use of improper technique and improper hand & finger rests and improper handling of instruments paves way to iatrogenic damages. The respondents reported post-operative sensitivity (37%) to be more common followed by inadvertent harm to adjacent tissues (32%).

One of the inevitable iatrogenic damage occurs during tooth preparation. Tooth preparation (cavity /crown preparation etc.) is usually done by high speed rotary instruments (20). In this situation, many dentists accidentally hit the bur to the adjacent areas. According to the respondents, a high prevalence of around 37% of damage was mainly caused due to the excessive tooth preparation lending the tooth weak (Interns, 47% > Final BDS, 37% > Third BDS, 22%). After this, 33% damage was caused to the adjacent tooth by chipping off the proximal side during preparation and high rotary speed. Inadvertent pulp exposure in tooth preparation was seen to be around 24% and 6% lacerations, due to the bur hitting adjacent mucosa. During tooth restorative procedures, improper placement and use of matrix band/wedge can result in inflammation of gingiva, especially the col which is non-keratinized.With a limited number of clamp sizes fitting an unlimited variety of tooth shapes, rubber dam clamps often gouge the gingiva and abrade the cementum and root surface, especially when inadequately seated and supported (21). Gingiva can be lacerated with resultant periodontal damage and bacteraemia when seating clamps (22). According to the respondents, regularly incorporated error during tooth restoration around 54% was due to the high points left on restoration, which may eventually disrupt the functioning of oro-neuromuscular system. As tooth preparation is mainly based on the principle that the restoration should follow the cusp and contours of the tooth during carving and finishing, failing to which high points could develop. To get a perfect contour and build proximal walls, matrix band is placed & during this placement, trauma induced to the gingiva was about 20%. Improper mixing and manipulation of cements and restorative materials and inadvertent placement of the restoration leads to trauma which was observed 18% of the time. Under-restoration leading to restoration failure was reported by 8% of the survey subjects.Through a rigorous preclinical training in conservative dentistry and endodontics, dental students are equipped with the skills needed to minimize such iatrogenic harm. Furthermore, it is necessary to plan the treatment with the use of radiographs and other diagnostic-investigation criteria, as well as to optimize patient preparation whenever possible.

Around 76% of respondents agreed that de nture stomatitis (Interns, 80% > Final BDS, 75% > Third BDS, 70%) can be caused by ill-fitting or improperly polished dentures, followed by passive-clasp activation which can cause periodontically weaken the strong abutment. In prosthetic
treatment, impressions are made with various therm oplastic and thermosetting materials. Thermal and chemical harm of soft and hard tissues may occur (5%). It can be challenging for dental students to perform paediatric treatments. The kids need to be trained to sit on the dental chair and become familiar with the dental operatory before beginning treatment.92 percent of iatrogenic trauma was caused by improper behaviour management of young children, which may result in psychological and negative dental attitudes, as opposed to 8% of soft tissue lacerations.

Dentists must not only relieve patient's pain but also empathize with them. They must try to prevent any unwanted maltreatment of their patients. It can be avoided at the basic level by gaining the in-depth knowledge required in carrying out any dental

procedure, staying abreast of recent developments to provide better treatment options for patients of various socio-economic backgrounds. Further charting out the treatment plan and informing the patient about subdue affects in the same, gaining patient's confidence is equally important (23). At the treatment level, taking preventive measures is the norm. Iatrogenic trauma can be reduced in future through a multitude of measures. Careful handling of instruments and materials is emphasized by 38% of the respondents, followed by proper isolation techniques (20%).The rest of the respondents suggested giving correct directions to patients during procedures (24 percent) and investing in building skills and accumulating experience (18 percent).Thus, this research demonstrates dental students' understanding of and practise with iatrogenic injuries that can occur during treatment. It gives us an idea of the most prevalent errors that can occur during normal dental operations, as well as the most commonly impacted site, so that preventative measures can be taken in the future.

V. CONCLUSION

There is a scarcity of research on prevalence of iatrogenic injuries in undergraduate dental students, thus this study was conducted. The evaluation and reporting of such injuries, as well as follow-up activities, should be discussed with the pupils. The value of maintaining records for future or medico-legal needs should be underlined. This will lead to a favourable dental treatment outcome and boost student confidence, preparing them for the future.

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