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Original Research

Microflora comparison and incidence of: Dry socket, infected or painful extraction socket and normal extraction socket following extraction of erupted tooth / teeth

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ABSTRACT:

Background: Exodontia being the most common procedure in dentistry & complications are inevitable. Dry socket, alveolar infection, and post-operative pain are common uneventful sequelae to extraction. Exact cause of dry socket is still unknown & microorganisms variable. The present study compared the microflora & incidence of dry socket, painful extraction socket and normal extraction socket following extraction of erupted tooth / teeth. **Materials & methods:** Healthy patients with willingness to participate in the study were selected from oral & maxillofacial surgery OPD of our institute. Post extraction incidence of Dry socket & alveolar infection are recorded alongwith the microorganisms inflicted with the condition. **Results:** Study involving 365 study subjects, age range of 15-75 years (male: female 219: 146) were evaluated for complications of exodontia. Higher age group (45-75 yrs) & alcohol consumption had a significant relation to incidence of dry & infected sockets. Also, ostectomy & odontomy during extractions showed significant relation with dry socket & infected socket. Dry socket was usually associated with streptococcus and pseudomonas auerginosa species where as painful sockets were associated with streptococcus, enterococcus faecalis, klebsiella pneumonia and streptococcus pyogenes species. **Conclusion:** Etiology of dry socket lesions is a topic of debate in the existing literature; although several factors such as smoking, oral contraceptive use, and the presence of fibrinolytic activity in post-extraction sockets are linked to an elevated risk of dry socket. Further studies should be conducted to evaluate the etiological factors and pathogenesis of dry and infected sockets.

Key words: Dry socket, Oral Microflora, Painful socket, Smoking, Tooth extraction.

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INTRODUCTION

Exodontia is a routine procedure in dentistry and may result in complications such as dry socket, alveolar infection, and post-operative pain. Dry socket / alveolar osteitis can present as a partially or completely dissolved blood clot within the alveolar socket with or without halitosis associated with postoperative pain surrounding the extraction site, which worsens between one and three days following extraction. [1]

Dry socket's exact etiology is unknown. Although many researchers have studied alveolar osteitis, the majority of concepts are still debatable. It is thought that dry socket occurs from increased fibrinolysis resulting in blood clot disintegration.[2]

The etiology of dry socket seems to be multifactorial - such factors include age, sex, use of oral contraceptives, smoking, traumatic / difficult extractions, poor oral hygiene, and vasoconstrictors used in local anesthetics.[3,4]

Hermesch et al [5] classified it into 3 types: superficial marginal alveolitis, suppurative alveolitis, and dry socket. In marginal alveolitis, the peri-alveolar mucosa becomes inflamed and gets partially covered by granulomatous tissue which is painful on mastication. In suppurative alveolitis, the clot becomes infected, covered by a grayish green

membrane and it may consists of dental fragments or osseous sequestrum. Pain is medium in intensity, accompanied by fever. In dry socket, the osseous walls of alveolus are exposed, with total or partial clot loss, dark in color which is often accompanied by fetid odor.

Microorganisms in dry socket cases are variable; *Streptococcus species* isolated in 35.7%, *Staphylococcus aureus golden* - 12.5%, *Actinomyces species* -10.7%, Candida spp. - 8.9%, *Enterococcus spp.* - 8.92, *Corynebacterium spp*. - 7.14%, *Esherichia coli* - 7.14%, *Staphylococcus pneumoniae* - 5.35%, *Clostridium species* - 3.6%.[6] Microorganisms can enter the post-extraction wound from odontogenic and non-odontogenic foci of chronic infection. Rozantis et al[7] investigated a putative link of *Actinomyces viscosus* & *Streptococcus mutans* in dry socket healing, finding delayed healing of extraction sites after inoculation of these bacteria in animal models. An experiment was conducted in the extraction sockets of rats and it showed that there was a higher level of serum C reactive protein along with this it also showed the potential of infection propagation and disturbance in the repairing process of alveolar osteitis.[8]

The present study compared the micro flora and incidence of dry socket, painful extraction socket and normal extraction socket following extraction of erupted tooth / teeth.

MATERIALS & METHODS

This prospective study planned to determine the microflora and incidence of pain persisting longer than 3-4 days, dry socket, and alveolar infection or painful extraction socket following the extraction of erupted tooth/teeth.

The study sample for the proposed study was taken from the population of patients who reported to the Oral & Maxillofacial Surgery OPD of our institute who fulfilled the required norms & regulations. A written consent was obtained from all the participants. The study was approved by the Institutional Ethical Committee.

INCLUSION CRITERIA

1. Good general health of patient as documented through self- assessment.
2. Willingness to participate in the study & must sign informed consent.

EXCLUSION CRITERIA

1. Patients with compromised immune system which may interfere with normal healing.
2. Patients with a history of allergy/hypersensitivity to drugs, antibiotics or any other agents being used in the study.
3. Unerupted/ Impacted third molars

All procedures performed under strict aseptic environment along with sterile armamentarium. Armamentarium included basic instruments for dental examination and routine extraction procedures, alongwith instruments required for curettage/debridement, suturing & Swab culture tubes. All the extractions were carried out under similar clinical conditions using 2% lignocaine with adrenaline (1:200000) for local anaesthesia and all surgeries aimed to be performed atraumatically. Standard post-operative instructions were given and routine post-operative medications prescribed to all the patients. Patients were advised to be reviewed at regular follow-up intervals. Clinical examination and assessment performed on regular follow-ups, followed by radiographic examination wherever required.

The clinical criteria for DRY SOCKET are as follows:

- Severe & persistent pain around the extraction site.
- Partial / total disintegrated blood clot with exposed alveolar bone.
- Presence of halitosis.

The clinical criteria for ALVEOLAR INFECTION are as follows:

- Suppuration/ intraoral abscess at extraction socket site.
- Pain persisting/ increasing 48 hours after surgery accompanied by intraoral inflammation (moderate or severe) and/or intraoral erythema (moderate or severe) with or without systemic fever.
- Persistent pain for no other justifiable reason that improves with medications.

Patient data was collected via a written questionnaire that was completed before and after surgery, as well as a swab culture report of the extraction socket. The swab culture tests were performed and the details of culture and sensitivity test evaluated. Specific sensitive antibiotics prescribed to the patients as per the reports and patients further evaluated on regular follow-ups.

Data was collated and statistical analysis was performed using descriptive statistics and the ANOVA test.

RESULTS

The present study included 365 study subjects, aged 15 to 75 years of age. The data obtained was subjected to statistical analysis using IBM SPSS version 20.0 software. Descriptive analysis was done for all variables, depicting mean, standard deviations, frequency and percentages. Statistical correlations between dependent variables were derived with the level of significance set at p-value=0.05.

A total of 365 subjects were evaluated, out of which 219 were males and 146 were females. Maximum subjects didn't have dry and infected sockets, among them 214 males and 144 females were with normal socket. It was observed that patients with 45-75 yrs age group were more prone to dry and infected socket. Statistically an insignificant relation (p-value>0.05) was observed regarding presence of dry socket and infected socket, in relation with gender and age groups.**(Table 1)**

Table l: Distribution of study subjects according to different variables and parameters

Variables		Dry socket			Odds ratio	Infected socket			Odds ratio	Normal socket			Odds ratio
		Yes	No	*P*		Yes	No	*P*		Yes	No	*P*	
Gender	Male	2	217	1.00	.748	3	216	.653	.497	214	5	.707	1.682
	Female	1	145			1	145			144	2		
Age	15-45yrs	1	194	.600	2.310	3	192	.626	.379	191	4	1.00	1.166
	45 -75 YRS	2	168			1	169			167	3		
Tooth site	Maxillary	1	222	1.00	1.695	1	222	0.629	2.552	221	2	0.461	0.469
	Mandibular	2	262			3	261			259	5		
Menstrual bleeding days	Yes	0	12	1.00	.993	1	11	.082	1.091	11	1	.158	0.83
	NO	1	133			0	134			133	1		
Oral contraceptives	Yes	0	36	1.00	--	0	36	1.00	.991	36	0	1.00	.982
	NO	1	109			1	109			108	2		
Presence of systemic disease	Yes	1	95	1.00	1.405	2	94	.283	2.840	93	3	.385	.468
	NO	2	267			2	267			265	4		
Tobacco consumption	Yes	2	103	.200	5.029	3	102	0.74	7.618	100	5	0.23	.155
	NO	1	259			1	259			258	2		
Alcohol consumption	Yes	2	76	.117	7.526	3	75	.032	11.440	73	5	.006	.102
	NO	1	286			1	286			285	2		
Report of difficult surgery/ extractions	Yes	2	89	.185	6.04	4	87	.004	1.046	85	6	.012	.126
	NO	1	273			0	274			273	1		
Duration of procedure	Upto 35 minutes	2	103	.200	.199	3	102	.074	.131	100	5	.023	6.450
	Above 35 minutes	1	259			1	259			258	2		
Post operative medications	Yes	3	362	--	--	4	361	--	--	358	7	--	--
	NO	0	0			0	0			0	0		
Post operative instructions followed	Yes	2	338	.192	.142	3	337	.248	.214	335	5	.077	5.826
	NO	1	24			1	24			23	2		
Use of flap	Yes	0	41	1.00	--	1	40	.380	2.675	40	1	.569	.755
	NO	3	321			3	321			318	6		
Ostectomy	Yes	2	46	.047	13.739	3	45	.008	21.067	43	5	.001	.055
	NO	1	316			1	316			315	2		
Odontomy	Yes	2	33	.025	19.939	3	32	.003	30.844	30	5	.000	.037
	NO	1	329			1	329			328	2		
Oral hygiene	Fair	1	124	1.0	0.960	1	124	1.00	0.637	123	2	1.00	1.309
	POOR	2	238			3	237			235	5		
Discharge from socket	Yes	0	24	1.00	--	3	21	.001	48.571	21	3	.007	.083
	NO	3	338			1	340			337	4		

A total of 223 patients were having maxillary tooth extraction and 264 had mandibular extractions. Dry socket is more common in mandibular region than maxillary area, with an insignificant relation statistically (p-value>0.05).

Among 12 patients with menstrual bleeding, no significant relation (p-value>0.05) was observed between menstrual bleeding and dry and infected socket.

In 36 patients who were taking oral contraceptives, socket was observed to be normal, with an insignificant relation between dry socket, infected as well as normal socket.

Among 96 patients with systemic diseases, 93 had normal socket, with no significant relation (p-value>0.05).

Out of 105 patients taking tobacco, 2 were having dry socket **(Fig. 1**) and 3 with infected socket **(Fig. 2)**.

Fig.1- Clinical picture of dry Socket.

Fig.2- Clinical picture of infected socket.

A statistically non-significant relationship (p-value>0.05) was observed between normal socket and tobacco consumption. Among 78 patients with alcohol consumption, a significant relation (p-value<0.05) was observed in relation to infected socket and normal socket.

Of 91 patients with history of difficult extraction or surgical extraction compared to dry socket, a statistically non significant relation was observed (p-value>0.05), whereas a significant relation was observed in relation to infected and normal socket. In most cases, it took more than 35 min for extraction. An insignificant relation was observed (p-value>0.05) in relation with dry and infected but in normal socket there were significant relation with p-value<0.05.

Post operative medications were given in all 365 patients, although in only 3 patients incidence of dry socket was observed.

In 340 patients, postoperative instructions were followed, with an insignificant relation (p-value>0.05) in relation with dry, infected and normal socket.

In 41 patients, flap was used for extractions, with an insignificant relation (p-value>0.05) in relation with dry, infected and normal socket. In 48 patients, ostectomy was done in the extractions with a significant relation (p-value<0.05) with dry socket, infected socket and normal socket. In 35 patients, odontomy was done showing significant relation (p-value<0.05) with dry socket, infected and normal socket.

240 patients had poor oral hygiene, but 235 patients were having normal socket and an insignificant relation (p-value>0.05) in relation with dry, infected and normal socket. 24 patients had discharge from the socket in which 3 patients had infected socket. The results showed statistically significant relation in infected and normal socket.

Normal extraction socket has pseudomonas

auerginosa and other oral commensals. Dry socket was found associated with streptococcus and pseudomonas auerginosa species where as painful socket was associated with streptococcus, enterococcus faecalis, klebsiella pneumonia and streptococcus pyogenes species. Periodontal microbial populations appear to be a major (although not exclusive) source of pathogens in other oral infections. Oral commensals include *Streptococcus, Actinomyces, Veillonella, Fusobacterium, Porphromonas, Prevotella, Treponema, Nisseria, Haemophilis, Eubacteria, Lactobacterium, Capnocytophaga, Eikenella, Leptotrichia, Peptostreptococcus, Staphylococcus*, and *Propionibacterium*. *Actinomyces* and *Arachnia* species are also commonly associated.

DISCUSSION

Dental extraction is a routine dental procedure and complications like pain, dry socket, infection can occur. Commonly complications of extraction are observed in mandible including iatrogenic and inflammatory complications. Iatrogenic complications include nerve injury, bone fractures etc., whereas inflammatory complications are delayed healing, dry socket, postoperative infection, postoperative pain, swelling, trismus, hematoma.[9-11]

Besides debilitating complications are rare but postoperative pain is a common complication of dental extraction. Most complications are minor and incidence is generally low, nevertheless extraction is the most frequent dental procedure, therefore the frequency of population's morbidity of complications may be noticeable. Thus it is required to identify the methods to control or reduce the post-operative extraction complications.[12]

In 1896, dry socket was first described by Crawford.[13] Various terms like alveolar osteitis, alveolitis, localized osteitis, alveolitis sicca dolorosa etc have been used to refer as dry socket.[1,14]

INCIDENCE OF DRY SOCKET AND INFECTED SOCKET

In present study, we observed that incidence of dry socket was 0.61%, and infected socket was 0.82%. This is in accordance with studies conducted by Field EA et al[14], MacGregor AJ[15], Turner PS[16] and Krough HW[17] who found that the incidence of Alveolar osteitis has been reported in the range 0.5% to 5%. In our study 0.91% males and 0.68% females with incidence of dry socket; whereas 1.36% males and 0.68% females were affected with infected socket. The maximum patients having dry socket were with age group 45-75 years. Akinbami BO et al[3] found that mean age of patients suffering with dry socket was 35.2yrs. Similar results were observed in studies by Cohen ME et al[18], Upadhyaya C et al[2], and Ogunlewe MO et al[19] with most of the patients in the fourth decade. Results of study by Amler MH[20] found that subjects were commonly aged in third decade.

In our study mandibular area was most commonly involved in case of dry and infected sockets than maxillary area. Similarly, Upadhyaya C et al[2] and Ogunlewe MO et al[19] also observed that mandibular teeth (68.4%) are more commonly involved than maxillary teeth.

RELATION WITH MENSTURAL CYCLE & ORAL CONTRACEPTIVES

Eshghpour M et al[21] assessed various risk factors for extraction complication including gender, age, amount of trauma during extraction, difficulty of surgery, inappropriate irrigation, infection, smoking, and oral contraceptive use. They observed that the frequency of AO was significantly greater in the middle of the cycle than during the menstrual period. The menstrual cycle may be a decisive risk factor in the frequency of dry socket according to the findings of this study. Oral Contraceptive users revealed a significantly greater frequency of AO compared with nonusers.

Controlling preoperative infection, maintaining good dental hygiene, avoiding trauma, and avoiding surgery on days 1 to 22 of the menstrual cycle in non-menopausal women may lower the incidence of dry socket in the study population, according to Oginni FO et al.[22] In 24.8 percent of the females, oral contraceptive use was elicited where extractions were done between days 1 and 22 of menstrual cycle.

In present study, menstrual bleeding was assessed as a risk factor. Among 12 patients with menstrual bleeding there was no significant relation (p-value>0.05) between menstrual bleeding and incidence of dry and infected socket.

In 36 patients who were taking oral contraceptives, socket was observed to be normal, with an insignificant relation between dry socket, infected as well as normal socket. It has been observed that oral contraceptive is the only medication associated with developing AO. Estrogen hormone is thought to play an important function in the fibrinolytic process. It is thought to cause lysis of the blood clot by indirectly activating the fibrinolytic system (by raising factors II, VII, VIII, X, and plasminogen), resulting in an increased incidence of dry socket.[23]

According to Sweet et al[24], an increase in the usage of oral contraceptives is associated with a higher risk of AO. According to Catellani et al[25], the risk of developing AO rises as the estrogen dose in oral contraceptives rises. When scheduling elective exodontia, Cohen ME et al[18] proposed that hormonal cycles be taken into account to lessen the risk of AO.

RELATION WITH SYSTEMIC DISEASES

Few studies have found that systemic diseases could be associated with alveolar osteitis.[26,27] Immunocompromised or diabetic patients, according

to Torres-Lagares D et al[28], are more likely to develop alveolar osteitis due to impaired healing. However, there is no scientific evidence to support a link between systemic disorders and AO. Eshghpour M et al[21] reported that the incidence of Dry Socket was 19.14%. Age, gender, systemic disorder, and antibiotics use prior to surgery revealed no significant associations with dry Socket. In present study, 96 patients were having systemic diseases, out of which 93 had normal socket, with no significant relation.

RELATION WITH TOBACCO & ALCOHOL CONSUMPTION

Out of 105 patients taking tobacco, 2 were having dry socket and 3 with infected socket. An insignificant relation (p-value>0.05) was observed between normal socket and tobacco consumption. Halabí D et al[29] found that the previous surgical site infection, traumatic extraction, and tobacco smoking are associated with an increased risk of alveolar osteitis.

Akinbami BO et al[3] also observed that alcohol consumption can increase incidence of dry socket. We observed that 78 patients were having alcohol consumption. A significant relation (p-value<0.05) was observed in relation to infected socket and normal socket.

RELATION WITH DIFFICULT EXTRACTION

The incidence of dry socket following non-surgical extractions was 0.35% while it was 2.1% following surgical extractions.[30,31] Mamoun J[30] found that difficulty in extraction can cause increased incidence of dry and infected socket. In our study, 91 patients were having difficulty in extraction or surgical extraction. In relation to dry socket, an insignificant relation was observed (p-value>0.05), whereas a significant relation was observed in relation to infected and normal socket. In most cases, it took more than 35 min for extraction. An insignificant relation was observed (p-value>0.05) in relation with dry and infected, whereas significant relation with normal socket.

Haraji et al[32] reported that the modified triangular flap decreases the incidence of Alveolar Osteitis more than the buccal envelope flap. In 41 patients flap was used after extraction, with an insignificant relation (p-value>0.05) in relation with dry, infected and normal socket. Cohen N et al[33] observed that ostectomy can increase incidence of dry socket, with an insignificant relation but in our study relation with dry socket, infected and normal was significant.

In 35 patients, odontomy was done showing significant relation (p-value<0.05) in relation with dry, infected and normal socket.

RELATION WITH MEDICATIONS

Hasan M et al[34] that antibiotics use prior to surgery revealed no significant associations with dry socket. In our study post operative medications were given in 365 patients out of whom only 3 had dry socket.

In 340 patients, postoperative instructions were followed, with an insignificant relation (p-value>0.05) in relation with dry, infected and normal socket.

RELATION WITH ORAL HYGIENE & DISCHARGE FROM THE SOCKET

A total 240 patients had poor oral hygiene, but 235 patients were having normal socket and an insignificant relation (p-value>0.05) in relation with dry, infected and normal socket. There was a significant association between fair/poor oral hygiene and dry socket, according to Akinbami BO et al[3], with p > 0.05 and 0.035. Discharge from socket showed significant relation with infected and normal socket.

CONCLUSION

The oral cavity harbors a surprising variety of microorganisms, some of which can cause several distinct oro-dental infections. Periodontal microbial populations appear to be a major (although not exclusive) source of pathogens in other oral infections. An enhanced understanding of the nature and etiology of oral infections has led to improvements in treatment. However, the variety of manifestations of infectious disease in the oral cavity, with lack of success in the treatment of some cases, continues to challenge researchers and clinicians.

Etiology of dry socket lesions is a topic of debate in the existing literature; although several factors such as smoking, oral contraceptive use, and the presence of fibrinolytic activity in post-extraction sockets are linked to an elevated risk of dry socket.

Iatrogenic factors like the type of extraction & instrumentation; expertise of a surgeon and subjective factors like compliance with postoperative instructions governs the occurrence of alveolar osteitis. Non compliance with postoperative instructions is the major cause of alveolar osteitis which most commonly includes spitting, gargling, using straw to drink & smoking. All these activities create negative pressure in oral cavity which dislodges the clot from socket.

Further studies should be conducted to evaluate the etiological factors and pathogenesis of dry and infected socket.

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