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1984

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Bischoff, P. J., Lownie, J. F., Cleaton-Jones, P. E. 1984. A clinical appraisal of various aetiological factors involved in dry socket (fibrinolytic alveolitis). Journal of the dental association of South Africa; 39(11):745-8

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Journal of the Dental Association of South Africa, 39, 745-748

A clinical appraisal of various aetiological factors involved in dry socket (Fibrinolytic Alveolitis)

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Keywords : dry socket; extractions

SUMMARY

Dry socket is a particularly unpleasant sequel complicating the extraction of teeth. Many authors have studied the multiple factors incriminated in the pathogenesis of this condition but no study has to date been conducted in the outpatient clinics of the Oral and Dental Teaching Hospital at the University of the Witwatersrand, Johannesburg. Following a pilot study of 100 individuals, 901 patients attending these clinics requiring the extraction of permanent teeth were surveyed. Information regarding the patient's previous dental history was recorded, as well as details of the operative procedure undertaken. Those patients returned with diagnosed cases of dry socket, the diagnosis based on certain predetermined criteria, formed the basis of this study. A total of 4,4 per cent of patients developed dry socket, which was most common in patients in the third and fourth decades. The prevalence in female patients was 6,3 per cent compared to 1,7 per cent in males. The choice of operative technique as well as the duration of the procedure affected the prevalence rates of dry socket. The mandible appeared to be the commoner jaw involved and the mandibular third molar the most common tooth.

OPSOMMING

'n Droë tandkas is 'n besonder onplesierige gevolg wat ná die verwydering van tande kan intree. Verskeie skrywers het die veelvoudige faktore betrokke by die patogenesis van hierdie toestand ondersoek, maar so 'n studie is tot dusver nie by die buitepasiënte-kliniek van die Mond- en Tandopleidingshospitaal van die Universiteit van die Witwatersrand, Johannesburg onderneem nie. Ná 'n loodsondersoek van 100 pasiënte is 901 pasiënte wat die kliniek besoek het vir die verwydering van tande ondersoek. Besonderhede aangaande die pasiënte se vorige tandheelkundige geskiedenis sowel as besonderhede van die operatiewe prosedure is opgeteken. Die pasiënte wat met gediagnoseerde droë tandkaste teruggekeer het (die diagnose is gebaseer op vooraf-bepaalde kriteria) het die basis van hierdie studie gevorm. 4,4 Persent van die pasiënte het droë tandkaste ontwikkel en dit het meesal voorgekom onder gevalle in hulle dertiger en viertiger jare. Die voorkoms onder vroue was 6,3 persent in vergelyking met 1,7 persent onder mans. Die keuse van operatiewe tegniek sowel as die duur van die prosedure het die voorkomsyfers van droë tandkaste beinvloed. Dit wil voorkom asof mandibula die kaak is en die mandibulêre derde molaar die tand is wat die meeste hierdeur geraak word.

Localised osteitis, also known as acute alveolar osteitis, constitutes a distressing postoperative complication associated with the extraction of teeth. The condition, commonly known as "dry socket", a term first coined by Crawford (1896), is sometimes referred to as alveolar osteitis (Thoma, 1969), alveolitis sicca dolorosa and more recently following work by Birn (1973), fibrinolytic alveolitis. In this paper the term "dry socket" will be used.

Prevalences have varied. Krogh (1937) reported that after the removal of 6 403 teeth, despite stringent postoperative care, 138 instances of dry socket ensued. In MacGregor's (1968) series of 10 199 extractions, 329 (3,2 per cent) dry sockets were noted in contrast to a more recent investigation by Archer (1975) who noted 226 (0,9 per cent) occurrences of dry socket following 23 886 extractions.

With regard to the causation of the condition, Thoma (1969) proposed that infection resulting from a "subvirulent" organism caused the condition, but provided no confirmatory evidence for this statement. Killey, Seward and Kay (1975) listed a number of general and local predisposing factors related to dry sockets, and among the general factors included debilitating diseases such as uncontrolled diabetes mellitus and nutritional disturbances such as hypoprotein-anaemia and scurvy. These authors felt that oral contraceptives might also be incriminated as might be anaemia and haemorrhagic diatheses. Local factors, they believed, include insufficient blood supply to the alveolus, preoperative infection, use of high levels of vasoconstrictor in local anaesthetic solutions, postoperative haemorrhage, trauma during extractions, postoperative infections, foreign bodies or root remnants, injudicious post-extraction lavage and fibrinolysis of the clot within the socket.

MacGregor (1968) could find no significant quantitative or qualitative difference between uninfected extraction sites and dry socket cases and concluded that infection plays a minor role as an aetiological factor. Brown, Mer-

rill and Allen (1970) in contrast found that those patients who develop the complication had higher pre- and post-operative levels of oral micro-organisms present than normal patients, streptococci being incriminated in their study, as well as in that of Archer (1975). Birn (1973) reported the presence of pre-existing pericoronal infection to be significant in the development of the condition after removal of mandibular third molars, even after the pericoronal infection had been controlled prior to removal of the teeth.

Killey *et al,* (1975) stressed the importance of the exposure of the denuded socket to the oral environment following disintegration of the blood clot. According to these authors, it appeared that early loss of the clot would lead to fresh haemorrhage and not an exposed dry socket. In contrast with the above findings, Butler and Sweet (1977) contended that high volume of post-operative lavage of the socket, using a 175 ml saline solution significantly reduced the incidence of localised osteitis.

A higher frequency of dry sockets in females using oral contraceptives was reported by Gersel-Pedersen (1977), purportedly as a result of increased ability to mobilise the fibrinolytic systm, thereby making the patient more vulnerable to the development of the condition. Similar results were found in the study of Butler and Sweet (1977).

The objectives of the present study were to investigate certain of the aetiological factors implicated in the development of dry socket and to establish a baseline for future comparative studies. Factors to be considered in this study were age and sex of the patient; reason for extraction of the tooth; distribution of the dry sockets; duration of operative procedure; type of surgical procedure; and type of anaesthetic technique used.

MATERIALS AND METHODS

One thousand and one patients of all ethnic groups attending the out-patient clinics of the division of Maxillofacial and Oral Surgery of the University of the Witwatersrand Oral and Dental Teaching Hospital formed the population sample for this prospective study. A protocol was submitted to, and approved by the Committee for Research on Human Subjects of the University of the Witwatersrand, prior to the commencement of this study. The subjects included in this investigation were all apparently fit patients over the age of 7 drawn from a broad cross-section of the community and were representative of the four main ethnic groups, namely blacks, coloureds, asiatics and whites. Children requiring extraction of deciduous teeth were excluded from the study because the condition is singularly rare before puberty (Birn, 1973). Treatment was performed by fourth, fifth and sixth year dental students under the supervision of the authors. The study did not include any patients judged to be in any way medically-compromised, such as diabetics, haemophiliacs and leukaemia patients. These patients were referred for admission to the Johannesburg General Hospital for further treatment prior to tooth extraction.

Results compiled from the first 100 patients by undergraduate students, were used as a pilot study to aid the design of the definitive study, conducted on 901 patients, which will be reported in this article. The survey encompassed both winter and summer periods, extending from July 1982 to March 1983, both months inclusive.

A questionnaire was formulated in such a way that data could be directly transferred onto computer punch cards. This questionnaire enabled the attending surgeon or student to document rapidly relevant details under four broad headings: personal particulars; history and examination; operative procedure; and postoperative assessment of complications.

The data were transferred to punch cards and analysed in an IBM 370/148 Computer using the Statistical Package for the Social Sciences (Nie *et al,* 1975). The statistical test used was the Chi-square test without Yates' correction and the minimum critical level of statistical significance chosen was $p<0,05$. When the number in a cell was less than five, grouping was done to increase this number.

RESULTS

In this study, a total of 1 617 teeth (815 maxillary, 802 mandibular) were extracted from 901 patients. The age of the patients in the series ranged from 9 – 89 years, the majority of patients, however, falling into the age group 20-49 years. Four hundred and seventy-five patients (54 per cent) were male and 523 (47 per cent) were female. The reasons for the extractions are listed in Table I. Fifty per cent of all teeth extracted in this study were carious, 23,1 per cent periodontally involved and 5 per cent were impacted. Thirty-nine extraction sockets in the mandible and one in the maxilla were diagnosed as dry sockets postoperatively (4,4 per cent of patients, or 2,4 per cent of teeth) and were successfully treated. The frequency distribution of dry sockets after mandibular tooth extraction shows that the majority of dry sockets in the mandible followed extraction of the third molar tooth (Table II). The prevalence of dry sockets in female patients was 6,4 per cent (27) and this was significantly greater ($p< 0,01$) than the 2,7 per cent (13) in male patients. Of a total of 40 patients who developed dry sockets, 7 (17,5 per cent) had a previous history of the condition, while 2 gave a history of excessive postoperative bleeding following previous dental extractions.

Table I: Reasons for extraction of various teeth.

Groups	Caries	Perio-dontal	Trauma	Pros-thetic	Impacted	Ortho-dontic
MAXILLA						
Molars	292	73	4	8	15	3
Premolars	128	44	3	22	0	11
Canines	33	13	3	8	1	0
Incisors	62	31	38	23	0	0
Total	515	161	48	61	16	14
%	63,3	19,8	5,9	7,5	1,9	1,8
MANDIBLE						
Molars	277	61	5	28	63	1
Pre-molars	74	59	6	33	1	17
Canines	11	29	3	21	0	0
Incisors	10	64	8	29	0	2
Total	372	213	22	111	64	20
%	46,4	26,6	2,7	13,8	8,0	2,5

In the outpatient clinics investigated, three methods of extracting teeth were used, namely intra-alveolar forceps extraction, transalveolar surgical approach and intermediate

Table II: Frequency of dry sockets in the mandible by teeth involved

MANDIBULAR TEETH	Dry Socket n	%
8	16	14,0
7	7	18,0
6	11	28,2
5	2	5,1
4	1	2,6
3	2	5,1
Total	39	100,00

combined approach where fractured roots were removed by the use of dental elevators with little or no reflection of a mucoperiosteal flap. The frequency distribution of dry socket and haemorrhage by each operative technique is shown in Table III and was highest with the combined technique. The period of time taken to remove the tooth from the mandible related to time, is listed in Table IV. It appears that prolonged procedures may carry a higher risk of developing postoperative complications, although this cannot be stated categorically from the statistics. The frequency distribution of dry socket and haemorrhage by choice of anaesthetic technique shows that more complications were associated with a block technique than with a combined block infiltration or infiltration technique performed individually (Table V). Of the 40 cases of dry socket which were seen, 26 (62 per cent) presented 1-3 days postoperatively, 12 (30 per cent) 3-7 days and 3 or 5 per cent more than 7 days after the surgical procedure had been carried out.

Table III: Frequency of complications by operative technique in the mandible

Technique	Dry Socket n	%	Haemorrhage n	%	None n	%
Intra-alveolar	13	2,6	6	1,2	274	54,7
Trans-alveolar	5	1,0	1	0,2	53	10,6
Combined	21	4,2	5	1,0	123	24,5
Total	39	7,8	12	2,4	450	89,8

Table IV: Frequency of complication in the mandible by duration of procedure

Duration	Dry Socket n	%	Haemorrhage n	%	None n	%
< 5 mins	12	2,4	5	1,0	250	50,0
< 10 mins	7	1,4	1	0,2	103	20,5
< 15 mins	8	1,6	0	0,0	32	6,3
> 15 mins	12	2,4	6	1,2	65	13,0
Total	39	7,8	12	2,4	450	89,8

Table V: Frequency of complications by choice of anaesthetic technique

Technique	Number n	%	Dry Socket n	%	Haemorrhage n	%	None n	%
Block	369	41,0	29	7,9	9	2,4	331	90,0
Infiltration	408	45,3	2	0,5	10	2,5	396	97,1
Combined	124	13,7	9	7,3	3	2,4	112	90,3
Total	901	100,0	40	4,4	22	2,4	839	93,2

DISCUSSION

The majority of patients treated during this trial were in the 20 – 49 year age group with a peak in the third decade. This correlates well with the study of MacGregor (1968), in which he reported that while the age of his sample ranged from 11 – 87 years of age, 50 per cent were under the age of 30, with a peak prevalence of dry socket between the ages of 30 – 34. Petersen (1957) showed a peak prevalence of 28 years for patients undergoing third molar removal. In the present study, there was a relatively small per centage of patients requiring the removal of impacted third molars. This can be explained by the fact that the majority of patients presenting at the Oral and Dental Teaching Hospital have third molar teeth removed under general anaesthetic and therefore very few formed part of the study. The statistically significant difference between the prevalences of dry socket in the maxilla and mandible can be explained by the difference in blood supply to these two bones. The distribution of the arterial blood supply to the mandible is quite different from that of the maxilla in that the mandible derives almost its entire blood supply from a single artery. A similar difference was noted by MacGregor (1968). The greater prevalence of dry socket in mandibular third molar extractions can be explained by the difficulty which may be encountered in extracting these teeth. In addition to this, pericoronal infection is commonest in mandibular third molar teeth.

The statistically significant difference in the prevalence of complications between females and males has also been shown by MacGregor (1968) and may be due to the fibrinolytic activity of endogenous or exogenous hormones, such as the oral contraceptive pill. This factor, as a cause of dry sockets, warrants further investigation and cannot be considered further in this paper.

It has been believed for some time that the more difficult an extraction may be, the greater is the chance of developing postoperative complications (Krogh 1937, MacGregor 1968). In this study "atraumatic" extractions exemplified by the intra-alveolar technique (Howe, 1971), carried the lowest risk of developing dry sockets. Conversely, the more traumatic the procedure, for example a combined forceps and elevator extraction in the case of fractured roots, the higher the risk. The importance of the anaesthetic technique used should be disregarded in this study, as firstly, the sample is too small and furthermore, block anaesthesia is used to anaesthetize mandibular teeth in contrast to infiltration for maxillary teeth and so a false association may be made. Finally, it is apparent that the largest number of dry sockets developed in the first three days postoperatively, which is in accordance with the work of Birn (1973).

This is the first study conducted at the Oral and Dental Teaching Hospital, University of the Witwatersrand, Johannesburg, so no previous figures related to the occurrence of dry socket are available from this source for comparison. Similarly there are no published figures from the other dental teaching hospitals in the Republic of South Africa.

Future studies could conceivably be conducted in either the hospital environment, as in this report, or in private practice. The outcome of such studies may enable the clinician to reduce significantly the prevalence of dry socket in either situation.

ACKNOWLEDGEMENTS

The authors wish to thank the Dean/Director, Professor J F van Reenen and the Senior Superintendent, Dr R A Corke of the Oral and Dental Teaching Hospital of the University of the Witwatersrand, for making the hospital facilities available to them, and to Mrs Wendy Schnider for typing the manuscript.

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