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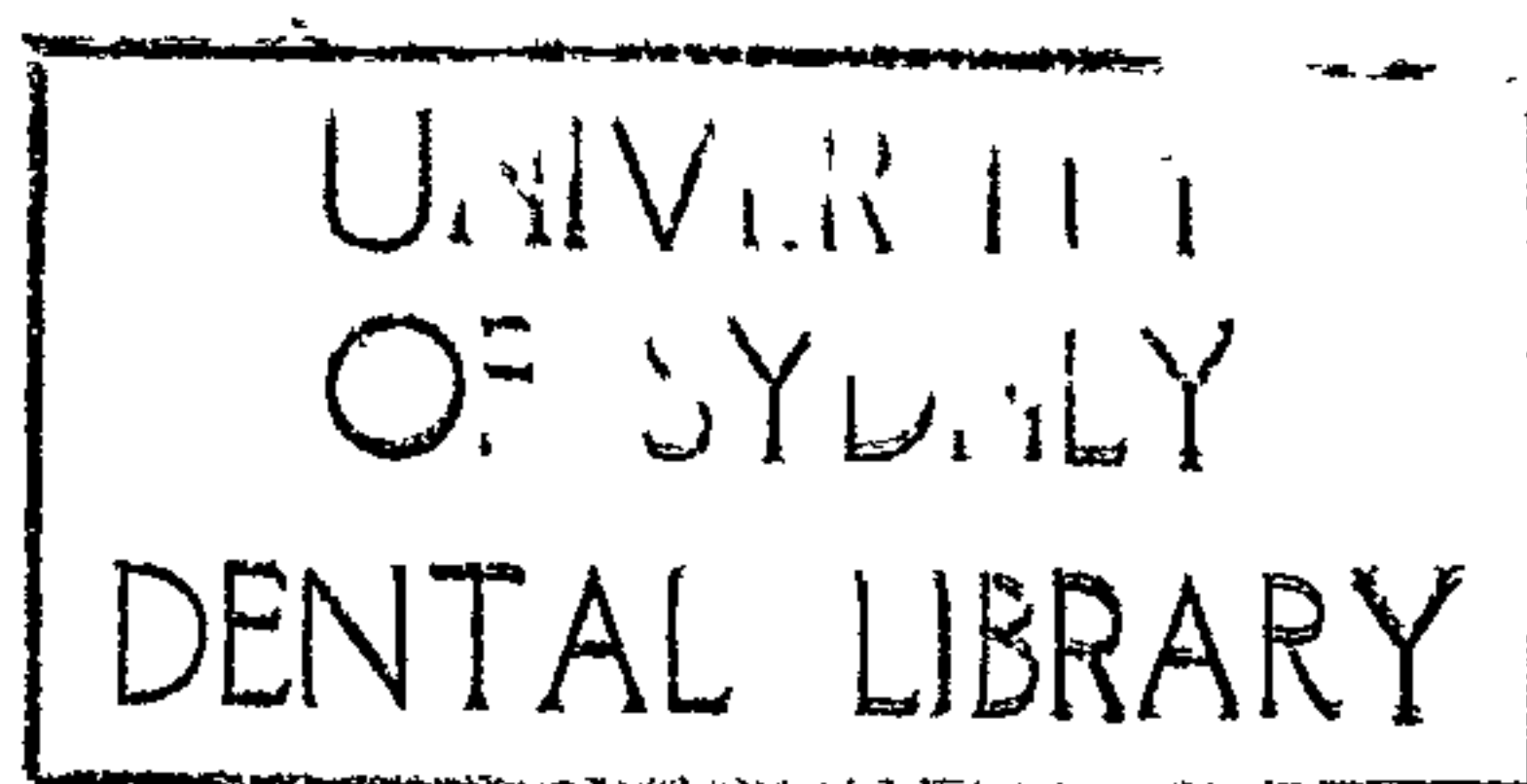
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STUDIES IN
DENTAL RADIOGRAPHY

A Thesis
in part fulfillment for
the degree of B.Sc. (Dent)
by
CRAIG TOMKO



April, 1985.

The University of Sydney

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PART 1:

A PANORAMIC ROENTGENOGRAPHIC SURVEY OF THREE HUNDRED (300) EDENTULOUS
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SYNOPSIS:

The purpose of this study was to determine the value of the panoramic radiograph as a diagnostic screening procedure for edentulous patients prior to full denture construction. The findings from 300 orthopantomographs were compared to those from a thorough clinical examination (including a relevant history) of the survey patients. Although over half the orthopantomographs were undiagnostic in some region, 210 dentofacial pathologies were found radiographically that were not detected clinically. In only 2 patients (3 retained roots) treatment was required but these instances of pathology certainly were not life threatening nor was treatment urgent. However, in two patients, with 6 retained roots between them, treatment had not been decided at the time of the survey, by the surgical staff. In terms of radiation exposure, time and cost, there would appear to be no real benefit from such screening procedures. The pendulum of dependence should be swung firmly back in favour of a thorough clinical examination and history taking for patient assessment. The value of selective radiography, based upon the clinical examination, employing selection criteria and professional judgement will be discussed for this specific demographic group.

REVIEW OF LITERATURE:

Previous studies have yielded a great deal of information regarding the frequency of pathological findings and subsequently the value of the radiographic process in treatment decision making.

Early surveys ^{1-5, 7, 23} employed full mouth periapical radiographs to statistically evaluate their findings in edentulous mouths; more specifically obvious pathoses in the jaws like retained roots and teeth. Included is a brief review of their findings (see Table 1). Each of the pathological entities are relatively constant in their incidence. The percentage of retained roots ranges from 15.7 - 31.2% while retained teeth ranges from 2.6 - 4.7%.

Table 1:

Percentage of radiographic findings in edentulous mouths.

Study	No. In Survey	Retained Roots	Retained Roots & Radiolucency	Retained Teeth	Foreign Bodies	Cysts	Overall Positive Findings
Cook '27	120	26.0%		2.6%			28.6%
Cheppe '36	190	30.5%		4.7%		0.95%	Unavail-able
Waggener, Austin '41	1,380	20.1%		3.7%*		0.8%	27.4%
Swensen '44	381	31.2%	3.0%				Unavail-able
Smith '46	1,000	15.7%		3.8%	2.1%	0.8%	22.4%
Edwards '51	1,050	26.0%		3.3%		2.0%	26.1%
Ettinger '71	538	21.4%	0.6%	3.3%	0.8%	1.8%	Unavail-able

* Includes supernumary teeth.

Occlusal films combined with periapical radiographs became the fashion for these investigative surveys ^{6, 8, 9} and in two cases, Michaeli, et al ¹⁸, Dachi, Howell ^{12, 13} only occlusal films were taken (see Table 2).

Table 2.

Percentage of pathological findings in edentulous mouths

Study	No.In Survey	Retained Roots	Retained Roots & Radiol- ucency	Retained Teeth	Foreign Bodies	Cysts	Overall Positive Findings
Ennis, Berry '49	1,002	24.4%	1.5%	2.7%	1.2%	1.0%	31.2%
Storer '57	500	25.2%		3.4%		3.0%	37.2%
Crandell '59	100	40 *	6 *	8 *	4 *	3 *	36.0%
Michaeli et al '68	117	8.5%		4.2%			17.1%
Dachi, Howell '61	Unavail- able	23.7%		2.6%			Unavail- able

* Unavailable as a percentage of those patients with these pathoses. The numeral represents the actual number of the individual entities.

Again relatively consistent results were obtained, except for the low incidence in the Michaeli et al ¹⁸ survey which could be explained by the small survey population and the sole dependence on occlusal films.

With the increasing popularity of panoramic radiography, it was logical to perform similar surveys using this new radiographic approach ^{21,22}. Because the panoramic radiograph has a larger anatomical coverage, other dentofacial abnormalities may be viewed that would not normally be seen by other radiographic means. The findings of Barclay, Donaldson ²¹ using a Panorex machine on a survey population of 100, revealed a very high incidence of retained roots (40%), retained teeth (4%), as well as other pathoses; Stylohyoid Ligament Calcification (7%) and other soft tissue calcifications in the rami region (5%).

Bremner, Grant ²² found positive findings in 41.4% of his 237 patients. Using an Orthopantomograph he found 125 retained roots, 44% of which were completely buried and 18% of which had associated radiolucencies. In comparing three types of panoramic machines, Alatter et al ³⁸ found impacted teeth (31.2%) retained roots (14.6%), Stylohyoid Ligament Calcification (9.9%), mucous retention phenomena (3.8%) and 24 residual and dentigerous cysts in 1,254 patients.

Scandrett et al ²⁶ compared the three methods of screening edentulous patients for residual pathoses. i.e. periapical, occlusal, panoramic surveys. He found the periapical survey yielded 37% unsuspected residual pathoses in the jaws. The occlusal survey missed 65% of the findings and the Parotex 25% of them.

One must bear in mind, though, that the panoramic survey may well have illicited information about other pathoses in the facial region, which the periapical survey would have missed. It seems, however, that this information is likely to be of no clinical value and is purely 'documentary' ⁴².

Surveys of pathological findings with no edentulous preference 10, 12-14, 16, 19, 20, 25, 32, 37, 45 are a valid form of comparison to the specific surveys discussed. A review of these findings is summarised in Table 3. The most noticeable feature is the lack of consistency in prevalence of the pathological entities. This is due to a combination of factors; the variability in the methodology and type of patients, and the lack, in most instances, of unified criteria. Because of the diagnostic inconsistencies between many surveys, radiopacities and radiolucencies may be used as broad criteria to cover a host of entities, e.g. cysts, osteosclerosis, parotid gland calcifications, etc.

The most interesting trend in these findings is the increased number of retained teeth and decreased retained roots when compared with the edentulous surveys. Obviously, this is an expected product of dentate arches, where fewer extractions have been performed and the larger number of panoramic surveys which enhance detection of third molar impaction. The findings of Tronje ³⁷ (over twice as many retained roots than retained teeth) is an exception to this rule but can be explained by the high number of edentulous subjects (272 edentulous jaws in 178 patients).

Keith ²⁵ stated that 25.8% of his findings required further treatment. Other significant findings of lesser pathoses included a range of 1.3 - 2.9% for mucous retention phenomena ^{16, 20, 25, 45} and 3.1 - 7.3% for osteosclerosis ^{14, 16, 43, 45}.

Table 3.

Findings in dentulous and mixed dentulous/edentulous surveys.

Study	No.In Survey	Retained Roots	Retained Roots & Radiolu- cency	# Retained Teeth	Foreign Bodies	Dentig- erous Residual Cysts	Overall Positive Findings
<u>I. Occlusal & periapical Survey</u>							
Crandell et al '60	519	14.3%	1.3%	7.5%	2.6%	1.3%	28.5%
<u>II. Occlusal Survey</u>							
Dachi, Howell '61.	3,874	17.3%	9.4%	16.7%			Unavail- able
<u>III. Panoramic Survey</u>							
Lilley, et al '65	1,287	25		202	4	8	Unavail- able
Cristen, et al '67	1,338	1.1%		8.0%	1.6%		28.4%
Cuttino, et al '69	1,415	4.9%		13.2%	3.6%		Unavail- able
Keith * '73	1,000	10.1%		27.0%	2.8%	3.7%	Unavail- able
Hansen * Johansen '76	111	8.1%		25.2%			Unavail- able
Tronje et al '80 *	178	41	10	16		4	81
Muhammed '82	300	7.0%		33.4%	1.3%	1.0%	Unavail- able
Barrett, et al '84 *	1,000	2.5%		2.0%	0.3%	0.5%	Unavail- able

Single numerals (without percentage) denote actual number of the individual entities.

* Orthopantomograph survey

Includes impacted, unerupted and supernumary teeth.

There were two important studies comparing the panoramic and other radiographic methods for detecting pathoses in this type of survey group. White, Weissman ³⁴ revealed in a survey comparing the Orthopantomograph and an intraoral set of radiographs, that the orthopantomograph found pathoses that were missed by intraoral films in 5.3% of patients (mainly mucous retention phenomena, stylohyoid ligament ossification).

The important point is that only one patient in 3,029 patients probably required further treatment. In another survey ⁴³ which had a similar comparison, it was observed that while the Panorex was most valuable in detecting calcified stylohyoid ligaments, osteosclerosis, ectopic calcifications, a periapical survey combined with bitewings was most accurate for detection of retained roots and a panorex plus bitewing survey for detection of impacted and unerupted teeth.

There is a vast amount of literature relating to other dentofacial pathoses which are commonly encountered on routine panoramic inspection, especially in view of their likely clinical importance. The value of this form of radiographic survey for analysis of jaw architecture, is also reviewed.

Stylohyoid ligament ossification is discussed in many articles, and the radiographic features, histology, and clinical manifestations and significance have been reviewed ^{21, 30, 37, 39}.

Similarly, pathology related to the maxillary sinus has been assessed and categorised ^{16, 27, 31, 37, 44}, especially in its relevance to detection by panoramic radiographs.

Ettinger ²³ gives an evaluation of the various types of cysts encountered in the edentulous patient. Goaz & White ^{40.A} supports Ettinger's criteria for cyst identification and management.

The relative unimportance of foreign body detection was observed ^{5, 23}.

Klineberg et al ³⁵ extolls the virtues of radiographic assessment prior to denture construction. He observes that compressive forces on the inferior alveolar nerve may cause discomfort, so the exact location of the mental foramen is desirable. The stress bearing capacity of bone can be revealed radiographically. Improperly calcified bone may lead to accelerated resorption when under denture load. The writer also suggests an assessment of the thickness of bone over the maxillary antrum since this 'reflects the stress bearing qualities of the maxillary denture foundation area'.

Sharp spicules of bone may not be apparent on clinical evaluation when a deal of mucosal hyperplasia is present. Radiographic determinant may alter the decisions on the occlusal plane location, the type of impression paste used and the denture base design ³⁶. The same author reflects on the advantages of dense bone.

Ettinger ²³ viewed the presence of anterior nutrient canals radiographically and correlated this finding with increased resorption of the residual ridge, especially with the absence of an overlying layer of compact bone.

The current survey employs panoramic radiography in the form of the orthopantomograph. Existing literature discusses the role and relative advantages and disadvantages of this method, a knowledge of which is paramount to its successful manipulation.

Panoramic radiography has been widely employed as a screening mechanism for large numbers of patients (a simple record of the general health of the population).

The initial evaluation of the panoramic radiograph by Updegrave ¹⁵ lists its wide anatomical coverage, its elimination of superimposed images of intervening structures, the observance of crestal bone continuity, the negligible scatter and leakage from panoramic units, and the low radiation exposure to the patient and operator, as its main advantages. These views are supported in the literature ^{16, 37, 43}. Kogan ⁴² reports that the radiation exposure is one-third that of a full mouth intraoral survey. Barclay, Donaldson ²¹ describe it as a 'rapid, reliable, effective, more readily acceptable procedure by patients than conventional intraoral series, but in no way replaces the intraoral periapical survey for detailed study'. Another advantage is that it can give complete coverage of a lesion to determine its extent and therefore aid any treatment decisions which need be made. Alattar et al ³⁸ reports the Orthopantomograph to be slightly better diagnostically than the films from Panorex and Panelipse units.

The uses of panoramic radiography have been well documented. The orthopantomograph is advantageous for nervous uncooperative patients, those patients with fractured jaws, trismus or gagging problems²⁵ as well as those with systemic contagious diseases, like Hepatitis B. According to Cristen¹⁶ it can be of diagnostic value in determination of growth and developmental patterns, temporomandibular joints, maxillary sinuses, mastoid regions and mandibular morphology. It is also useful for evaluation of jaw architecture, principally bone density, alveolar ridge regularity, vertical bone height, canals and foramina locations and vertical dimension (before and after treatment)^{26, 36}.

Kogan⁴² reports that although the substitute of panoramic film for full mouth surveys in a screening role, represents a decrease in radiation to the patient, the lack of treatment related information obtained by this routine exposure in his survey is evidence of unproductive use of radiation. This aspect will be discussed later.

The advantages and uses of the panoramic radiography is weighed against its disadvantages in the literature. Perhaps the biggest disadvantage is that it has become a status of excellence in dental treatment⁴² which has increased its popularity and consequently an over-reliance has meant imprudent use in many facets of roentgenographic diagnosis. The literature^{15, 21, 22, 25} enlightens us on the inferior definition and detail of the process (due to the use of intensifying screens and an increased object/film distance) and the degree of inherent distortion due to motion (especially in the vertical plane²⁴). Bremner, Grant²² suggests that because of a 2 cm. wide vertical overexposed central strip of film in orthopantomographs that intra-oral films may need to be taken in midline regions because this area is often undiagnostic. Kogan⁴² supports this criticism of the orthopantomograph as well as describing the difficulty in patient positioning, the cost of the machine, the problem of ghost images, and the necessity to continually alter the kVp for individual patients. In fact, one survey found that 57% of maxillary sinuses were undiagnostic in orthopantomographs³⁷.

Additionally, areas of diagnostic interest outside the focal trough are poorly visualised, if at all, and the amount of vertical and horizontal distortion varies from one part to another, further reducing the accuracy of the film. However, Frykholm³³ contends, by demonstration mathematically and experimentally, that within certain specified

limits, the orthopantomograph image may be reliable for angular measurements.

Recent surveys have a more tenable and accurate approach to their methodology than early surveys, which though enthusiastic, missed ways of reducing examiner errors and were naive in their compilation of results.

Although there was no choice in the type of panoramic machine available for use, the orthopantomograph has been proven by most studies to be the most diagnostically accurate³⁸. Other studies have stressed the importance of a thorough clinical evaluation before the decision to opt for a panoramic radiograph, particularly Barrett et al⁴⁵. Indeed, the design of the current study revolves around this discipline of thorough clinical assessment. Recent surveys^{25, 32, 34, 37, 38, 45, 46} employ standardised viewing conditions. With the recent know-how regarding visual acuity and enhanced optimal diagnostic viewing, thus being so much more scientific, this type of approach was adopted in the present survey. Many studies employed more than one observer to reduce examiner bias, as well as conditioning the examiner in trial surveys to reduce inter examiner bias. Keith²⁵, in fact, re-examined films randomly to demonstrate if the examiner was consistent. Scandrett²⁶ randomised the whole procedure of patient selection and radiographic viewing.

One of the most contentious issues discussed in the literature was whether retained roots and teeth should be removed. Obviously, this is extremely relevant in view of the consistency of their findings throughout the surveys. Current opinion on treatment decisions has changed from that of the early studies. It is an interesting progression as is the changing attitudes to decision making. The early textbooks, (Mead, Archer, Clark) recommended all root fragments be removed. Smith⁵ supported this view for exposed root tips, which were a potential site for infection and with dentures causing intermittent pressure, could be an area of menace. Dachi, Howell¹² states 'the decision to remove these should take into account the presence or absence of radiographic or clinical signs of infection, the extent of surgical procedure required, general condition of the patient and risk of normal roots becoming subsequently infected'. They also concluded, that retained roots lying

partly in soft tissue or partly exposed to the oral cavity, had a greater probability of being infected than deeply buried roots. Their high results for retained roots with associated radiolucencies were due to the high number of roots which were exposed and the fact that any evidence of "thickening" or a narrow area of bone loss around any part of the root was classified as such.

Some studies suggest the high incidence of retained roots was due to poor dental care ^{11, 18, 26}, but Barclay, Donaldson ²¹ contends that because most root tips are found within the posterior maxilla, it is due to poor visibility and the proximity of the maxillary antrum, in an area where extraction of teeth is difficult anyway. Ettinger ²³ adds that the absence of radiographic survey may also be a cause. Herd ²⁹, in a histological assessment of retained roots states 'that in the absence of clinical and roentgenographic abnormalities the tooth root can be regarded as having been accepted by the tissues'. There is greater chance of immediate acceptance if the pulp is vital at the time of fracture.

There is general agreement though ²¹⁻²³, that where obvious infection or pain exists, treatment must be aimed at its eradication, even though the majority of roots are not infected and they remain in the jaws indefinitely without causing any clinical symptoms ²⁹, and that there is no evidence that root fragments acted as sites of focal infection when in situ. Ettinger ²³ points out, that the ability of the patient to wear dentures depends on bony support and removing roots haphazardly unnecessarily destroys bone or hastens its resorption. Countering this argument, are those cases where the root may be asymptomatic, yet at some stage comes to the surface, causing irritation. It may be advisable to remove it in such instances while the patient is still healthy enough to tolerate such an operation ²⁹.

Radiopacities associated with retained roots are not of clinical importance although this sclerosing effect may have made the root more susceptible to fracture ²⁹.

Smith ⁵ expressed his opinions on the treatment of retained teeth. He agreed with Molt that if there is the slightest aperture in the epithelial lining of the tooth crown, permitting ingress of mouth fluids, one can definitely state infection exists. Pressure produced by a

denture upon an unerupted tooth lying close to the surface, may cause it to erupt ³⁵, and cause inflammation, pain and discomfort. Smith ⁵ concluded that there is the possibility that these teeth may be potential sites of infection and their presence may cause cyst formation and neuralgia. It is advisable that these teeth be removed before denture construction (especially if the process would not be tolerated at a later stage ^{13, 21}, due to ankylosis or ill health, unless they are completely buried, if there are no signs of cyst formation or if the teeth lie close to the inferior dental canal.

Smith's views are shared by several authors ^{13, 14, 21}.

The ameloblastic change of a dentigerous cyst surrounding an impacted tooth crown cannot be overlooked. If no treatment is prescribed, routine radiographs should be taken to ensure the follicular space does not enlarge ¹⁴. The concern over this entity forced Dachi, Howell ¹³ to recommend that all retained teeth be prophylactically removed due to their high incidence.

The most contentious issue reported in the literature is the consideration of routine radiographic screening for diagnosis of pathological entities in the jaws. Most literature had advocated routine use, but a trend over recent years has suggested this is unnecessary radiation and cost to the population for little benefit. They suggest clinical judgements have been sacrificed for radiographic dependence and that only selective radiographs be taken when specific selection criteria have been satisfied.

Early surveys employing full mouth periapical or occlusal radiographs ^{5, 9, 10}, strongly recommend routine radiographic screening because it is the 'only means of detecting pathological conditions which lie beneath the mucosa of the edentulous dental arch! These opinions were shared by many panoramic investigators ^{19, 20, 25}, with special reference to those totally edentulous surveys ^{23, 26, 28, 34}. Morris ¹⁹ states panoramic radiographic screening was valuable when combined with a

Polaroid photograph for dentate patients, whereas Cuttino et al ²⁰, suggests, it should be used with bitewings as a screening method. Keith ²⁵ on the strength of finding 25.8% of patients who required further treatment, agreed with the use of the orthopantomograph for screening purposes. However, his logic for this conclusion has come under scrutiny.

Barrett ⁴⁵ posed a valid criticism of several studies ^{14, 19, 25}, stating that they did not evaluate the risk-benefit relationship of pathological findings by radiographic means. They do not distinguish between unexpected findings and findings which would have been predicted by clinical examination and selected intra-oral radiographs. They do not balance the number of findings against their clinical importance. They do not balance the number of characteristics (age, sex) of patients in whom no abnormalities were detected against those that did.

Of the purely edentulous surveys, Ettinger ²³, reports, it is an integral part of diagnosis and treatment planning in full denture construction, and should be utilised even in the absence of clinical signs and healthy mucosa. Scandrett et al ²⁶ agrees, on the basis of the high prevalence of residual pathoses found in edentulous patients. However, the author queries whether the panoramic radiograph shows sufficient detail to justify the elimination of intra-oral radiography from screening of edentulous patients. However, the need for accurate anatomic reproduction is usually less in edentulous patients. Their value is in detecting residual infection, foreign bodies, osseous alterations that might detract from the patients' health and interfere with or contra-indicate artificial dentures ²⁸.

White, Weissmen ³⁴, though disagreeing with screening every patient, suggests panoramic radiographs provide a valuable screening service for edentulous patients, but queries how reasonable it is to expose patients for only a slight probability of detection.

Taking the alternate view, Santangelo ⁴¹ points out that public attention has been focussed on the overuse of low level ionising radiation. He concludes the panoramic radiography must never be used as a screening examination when they are not expected to add new information or when supplemented to a full mouth survey. 'They are totally unjustified when taken prior to a thorough clinical examination and are not based on those findings', and on an evaluation of dental, oral and medical health of the

patient, and a professional assessment of the benefit versus risk. Lastly, the author warns of the potential for overreliance of dentists on radiographs ^{41, 45}. Kogan, Stephens ⁴² supports this viewpoint - 'reliance on clinical criteria appears a safe, effective method of selecting radiographs and contributing to radiation thrift... It is now believed that only in the field of patient selection, can significant further reductions in population exposure be achieved.' The authors suggest that screening films are based on two considerations, a) a safety for failure to detect a hidden lesion b) for diagnosing and treating dental disease as well as identifying early signs of systemic disease. These seem invalid considerations because the chance of disclosing a life threatening disease is absolutely minute and the only findings are usually "documentary" and no treatment is required anyway. Lloyd, Gambert ⁴⁶ reported there was little value in a radiographic survey in elderly edentulous patients.

White et al ⁴⁷ found by using specific indications for panoramic radiographs they could decrease the number of films by 96% and only miss one-third of the findings.

Barrett et al ⁴⁵ reported in their survey, that the diagnostic yield and clinical importance of pathoses detected was low. Since they were mainly young patients in their survey (and particularly females of child bearing age) it seemed routine screening was contraindicated. Their role should be purely supplementary.

METHOD AND MATERIALS:

The approach to this study was basically to examine the difference between clinical and radiographic findings in a selected population and to eliminate any preconceived notions by way of faultless methodology. This was achieved by analysis of the desirable features and inherent errors in the methodology of the relevant studies and by a thorough grounding in radiographic interpretation and principles. Had this perspective not been attained, the values gained and thereby the judgments upon which these were based would have been entirely invalid. The time spent in this area was just as valuable as the time spent on the survey proper.

Three hundred edentulous patients were randomly selected by dentists employed in the Examinations Department, United Dental Hospital, Sydney. The only consistent criteria were they be edentulous and would have at some stage have a complete maxillo-mandibular prostheses manufactured at the hospital. A thorough clinical examination was performed on these patients. This lasted between 10 - 15 minutes but obviously became slightly quicker with repetition. The criteria used are shown on the sample examination form, as is the type of historical information which should be gleaned from the patient during this appointment. i.e. "How long have you been edentulous?" "What is the major reason for which you came?"

For convenience and easy reference, the survey form was divided into: a) analysis of the denture bearing areas to give an indication of the jaw architecture and whether any abnormalities present would effect denture construction, as well as providing a comparison of normal edentulous anatomy between clinical and radiographic viewing. b) radiopaque areas - this term is not applicable clinically, however it concerns any calcifications or retained objects which may be palpated. c) radiolucent areas - similarly not applicable clinically, but any bony expansion which may be viewed or palpated is suggestive of a radiolucency.

Where any abnormality was detected, a description of the position and the type of mucosal changes associated with it, were recorded so as to balance the input of information. An example of a completed clinical form is included. (Refer Appendix "A")

On completion of the clinical examination, each patient was sent for a panoramic radiograph. The Department of Radiology employs a Seimens OP 5 for these radiographs. The machine has an inherent and added filtration of 2.0 mmAl, mA 15, 15 second exposure time. The Department uses Kodak Ortho G 12.7 x 30 cm film and an automatic developer is utilised. Experienced operators vary the kVp between 65, 70, 75, according to jaw size in order to maintain a consistant radiographic density.

In all cases at least four weeks elapsed before viewing of the radiographs. This, obviously, was aimed at removing any prior knowledge concerning the individual patients. Using the same criteria as the clinical examination (with a few applicable alterations) and after blocking out the clinical results, the orthopantomographs were analysed under standardised, optimal viewing conditions. This included a darkened room, a viewbox from which extraneous light was removed, and a x 1.5 magnifying glass. Under these conditions, visual acuity is optimised.

The radiographic analysis was performed with a thorough knowledge of the roentgenographic appearance of all types of pathoses likely to be found in the jaws and associated structures. Where any doubt existed, the decision was confirmed by an experienced independent viewer. Again, a brief description of the lesion is given.

An example of a completed radiographic form is included. Note the assessments of the diagnostic incapacity of the orthopantomograph and the inclusion of any treatment decisions subsequent to the clinical examination, e.g. removal of retained root. (Refer Appendix "B")

The findings were categorised and further classified in order to observe any relation between some criteria and the requirement of panoramic radiography for detection of pathoses. These categories included age, sex, reason for attendance, and simply individually comparing clinical and roentgenographic findings. The analysis of data was performed en bloc and without bias. Because of the nature of the survey analysis (i.e. with a range of categories), results could be cross-checked to ensure their accuracy.

RESULTS:CHARACTERISTICS OF THE SURVEY GROUP:

The age distribution and mean age are shown in Table 1. The majority of subjects (63.7%) were female, whilst (83.3%) were aged between 50-79 years old.

Table 1: Age Distribution

Range: 24-86 years

Mean: 64 years

Age Distribution	Male	Female
20-29	2	2
30-39	1	7
40-49	10	11
50-59	14	37
60-69	46	78
70-79	27	48
80-89	<u>9</u>	<u>8</u>
	<u>109</u>	<u>191</u>

For convenience and logistic reasons the age distribution was further grouped into several subgroups, e.g. < 40: 40 to 59 years: between 60 and 69 years: > 69.

The reason for attendance was obtained by asking the patient "What is the major reason for which you came to the hospital?" The findings are shown in Table II, and an explanation of the categories follows:

Table II: Age Distribution According to Reason for Attendance

Age Distribution	n	New F/F	Renew F/F	Denture Pain	Misc.
Under 40	12	2	9	1	0
40-59	72	11	53	6	2
60-69	124	10	77	32	10*****
Over 70	92	2	69	17	6**
Total	300	25	208	56	18*****

* signifies each patient with denture pain as well.

- New F/F - requires F/F but has never worn them before
- Renew F/F - requires F/F but existing dentures are problematical, e.g. 'loose', 'ill-fitting', 'old thin', 'broken', aesthetics .
- Denture Pain - relating specifically to denture bearing areas, i.e. constant ulceration.
- Miscellaneous - other reasons, e.g. TMJ clicking, angular cheilitis, 'speech difficulties', 'indigestion', 'numbness', TMJ pain, facial palsy, 'check-up', 'don't know'.

When the reason for attendance was related to the sex of the patient, an interesting pattern emerged (Table III). Male patients were more likely to have less associated denture pain and when compared to women they required completely new F/F more often.

Table III:
Sex Related to Reason for Attendance:

Sex	n	New F/F	Renew F/F	Denture Pain	Misc.
Male	109 (36.3%)	17	73	15	5
Female	191 (63.7%)	8	135	41	13

Histories revealed twelve patients had had previous oral surgical treatment; the most common reason was for the removal of retained roots in 7 instances, then 'bone removal' in 3 instances, and 'tooth removal'

in 2 instances. This represents an overall rate of 4%.

In no case did the medical history reveal a pathological disease related to the jaws.

The number of years in which the patients had been completely edentulous revealed an expected increase as the patient age categories became higher. This trend continued as to the length of time their existing dentures had lasted. For comparison, average length of time for existing dentures in the 40-49 group was (9.9) years, whereas in the 80-89 group, it was (20.1) years.

DIAGNOSTIC QUALITY OF THE RADIOGRAPHS

When viewing the radiograph, the first question asked was 'Are there any areas on the radiograph which are undiagnostic?'. The findings are shown in Table IV.

Table IV:

<u>Undiagnostic Regions on Orthopantomograph</u>	
Whole Orthopantomograph	1
Whole Maxilla	20
Half Maxilla	4
Anterior Maxilla	71
Anterior Mandible	11
Anterior Maxilla and Anterior Mandible	54
Whole Mandible	<u>1</u>
TOTAL	<u>162</u>

The important feature here was that over half (54%) of the Orthopantomographs were undiagnostic in some region. In particular, the anterior maxilla was undiagnostic in 48.7% of cases and the anterior mandible in 22.3% of cases.

In addition, seven non-pathological densely opaque artifacts were found, their position and radiographic features being such that they could not be confused with a pathological entity or iatrogenic condition, e.g. amalgam.

RADIOPAQUE ENTITIES:

a) Retained Roots: The prevalence of retained roots is shown in Table V along with their treatment options. An example of multiple retained roots in both the soft tissue and completely embedded in bone is shown in Radiograph #1.

Table V: Retained Roots

Age	n	Sex	No. of Retained Roots	Treatment Options (of those seen radiographically, not clinically).		
				Treatment Required	No Treatment Required	Undecided
< 40	12 (4%)	F	1 (1)	-	1	-
		M	-	-	-	-
		Sub Total	1 (1)	0	1	0
40-59	72 (24%)	F	35 (10)	2	12	5
		M	2 (2)	-	-	-
		Sub Total	37 (12)	2	12	5
60-69	124 (41%)	F	9 (5)	-	5	1
		M	11 (9)	-	7	1
		Sub Total	20 (14)	0	12	2
> 70	92 (31%)	F	8 (7)	1	4	-
		M	2 (2)	-	-	-
		Sub Total	10 (9)	1	4	0
TOTALS	300 (100%)		68 (36)	3	29	7

N.B. Bracketed numbers indicate the number of individual patients.

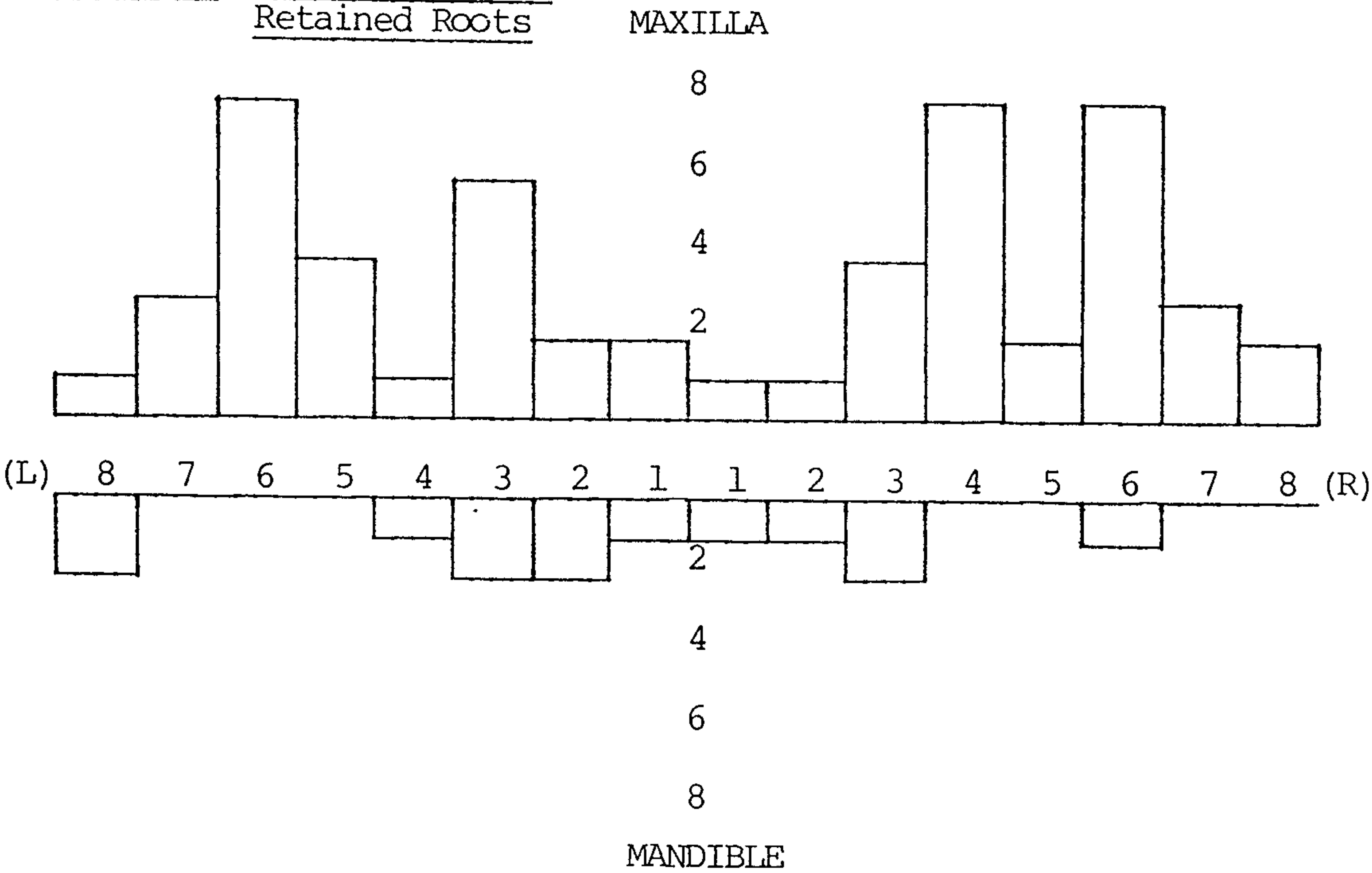
Thirty-nine roots were seen radiographically but not clinically. Of these the following were observed, viz;

- i. 3 retained roots in (2) patients required treatment
- ii. 29 retained roots required no treatment
- iii. 7 retained roots in (3) patients, treatment has been undecided.
- iv. 1 root was misdiagnosed clinically and found not to be present radiographically.

Of the retained roots palpated clinically, 21 were exposed, 8 were palpated in soft tissue and 1 had a fistulous tract.

Only 22% of the retained roots were found in males although they comprise 36% of the survey population. The vast majority of retained roots (82%) were in the maxilla. The distribution of retained roots, according to their position in the arch is shown in Figure 1.

Figure 1: Distribution of Retained Roots



Overall 12% of patients had one or more retained roots. Of these 11.8% had an associated radiolucency, while one retained root had an associated radiopacity. Thirty-two percent approximately were classified as root tips (being one-third or less their original root size) and the remaining 67.6% were the larger root fragments.

b) Retained Teeth: The prevalence of retained teeth is shown in Table VI.

Table VI: Retained Teeth

Age	n	Sex	No. of Retained Teeth	Treatment Options. (of those seen radiographically, not palpated clinically)		
				Treatment Required	No Treatment Required	Undecided
< 40	12 (4%)	F	-	-	-	-
		M	-	-	-	-
		Sub Total	0	0	0	0
40-59	72 (24%)	F	-	-	-	-
		M	-	-	-	-
		Sub Total	0	0	0	0
60-69	124 (41%)	F	5 (4)	-	1	-
		M	1 (1)	-	1	-
		Sub Total	6 (5)	-	2	-
> 70	92 (31%)	F	2 (1)	-	-	-
		M	1 (1)	-	-	-
		Sub Total	3 (2)	0	0	0
TOTALS	300 (100%)		9 (7)	0	2	0

N.B. Bracketed numbers indicate the number of individual patients.

Overall (2.3%) of patients had one or more retained teeth. Of the nine retained teeth there were the following: 5 impacted teeth, 3 unerupted teeth and 2 supernumery teeth in the form of mesiodens (see Radiograph #2).

The unerupted/impacted classification was made on the basis of whether they were in a position to erupt. Two teeth were detected radiographically that were not palpated clinically and both required no treatment.

There was an even distribution of retained teeth between the mandible and maxilla. One retained tooth was misdiagnosed on the Orthopantomograph and found not to be as such on a periapical radiograph and was not included in the study. No retained teeth had an associated radiolucency. (an example of an unerupted tooth is shown in Radiograph #3).

c) Calcifications, Ossifications and Miscellaneous Radiopacities

The incidence of these individual entities is shown on Table VII. These findings are what some authors describe as 'documentary'. There was no evidence of any of these entities clinically. However, all conditions were asymptomatic and did not require treatment.

Table VII: Calcifications and Miscellaneous Radiopacities:

		A G E G R O U P				
		Under 40	40-59	60-69	Over 70	Total
<u>Osteosclerosis</u>	n	12	72	124	92	300
	Maxillary	1	4	6	10 (8)	21 (19)
	Mandibular	-	5	5	8 (8)	18 (18)
	Total	1	9	11	18 (16)	39 (37)
<u>Stylohyoid Ligament Ossification</u>						
	< 1/2 advanced	-	24 (13)	23 (13)	22 (12)	69 (38)
	> 1/2 advanced	-	2 (1)	6 (3)	6 (4)	14 (8)
<u>Ectopic Calcifications #</u>		-	5 (5)	12 (11)	11 (8)	28 (24)
<u>Antroliths</u>		1 (1)	4 (4)	3 (2)	1 (1)	9 (8)
<u>Mucous Retention Phenomena</u>		-	-	2 (2)	2 (2)	4 (4)
Other *		-	3 (3)	4 (3)	7 (6)	14 (12)
TOTAL		1 (1)	38 (26)	50 (34)	49 (33)	138 (94)

N.B. Bracketed numbers indicate the number of individual patients.

* 'Other' includes: Miscellaneous opacities, TMJ spurs, lateral pterygoid calcifications, mucocele.

Denotes calcifications of parotid gland, cervical lymph nodes, submandibular gland.

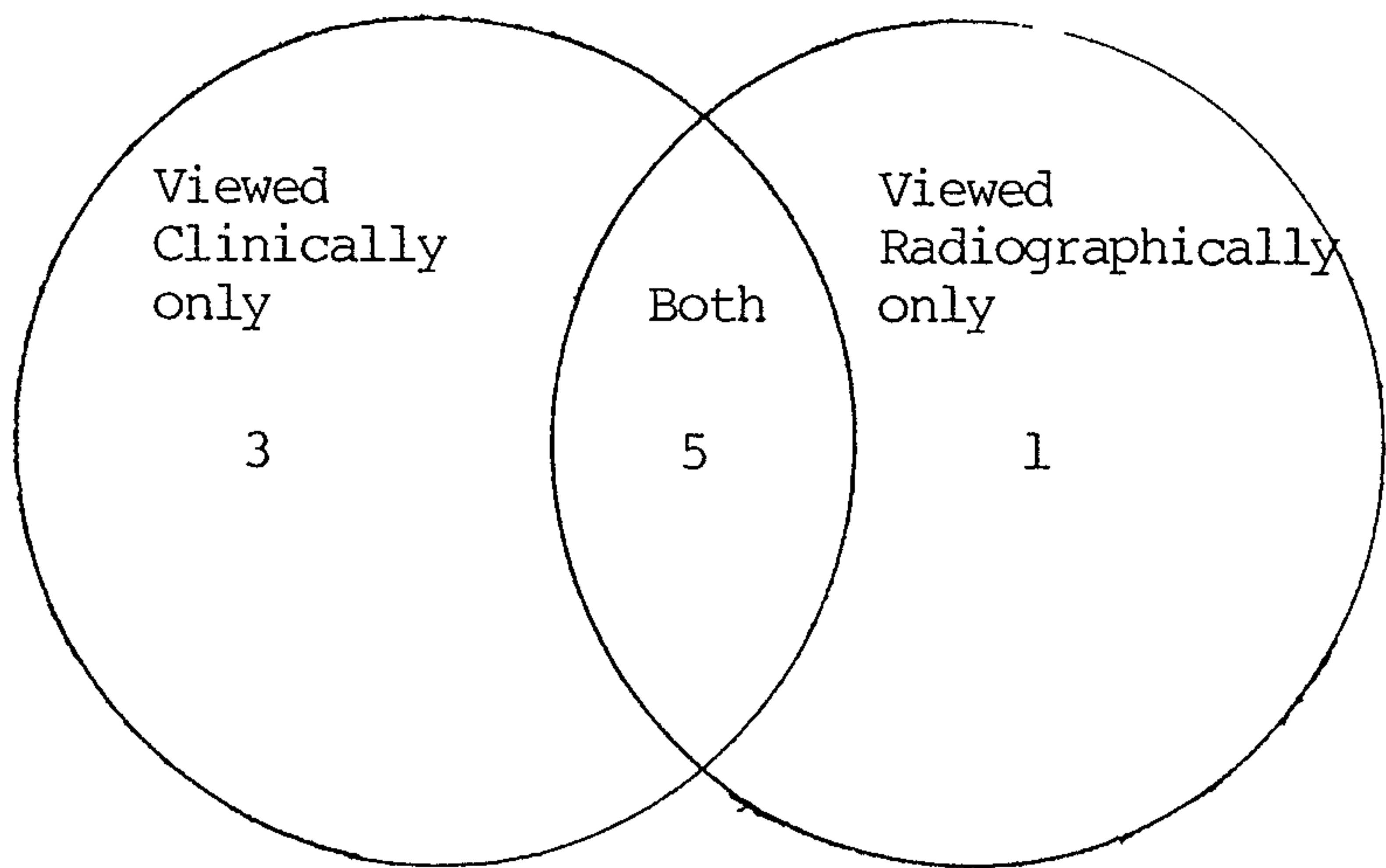
Overall in males there were 49 findings in (33 patients) and in females there were 89 findings in (61 patients). In these categories an even distribution between the sexes is represented when one considers the larger proportion (63.7%) of women in the study.

Stylohyoid ligament ossification occurred in 15.3% of the survey population (an example of almost complete ossification is shown in Radiograph #4). Ectopic calcifications had a prevalence of 8% (bilateral multiple examples are depicted in Radiograph #5). Nine antraloliths were detected (Radiograph #6 is the only case in which this entity was bilateral). Four cases of mucous retention phenomena were observed (see Radiograph #7). The 'other' category included an unusual entity, that of lateral pterygoid calcification (see Radiograph #8).

d) Foreign Bodies:

Figure 2 illustrates the clinical and radiographic findings. All foreign bodies were amalgam fragments.

Figure 2:



Orthopantomographs confirmed five of the eight clinically evident amalgam tattoos. In one case amalgam fragments were evident radiographically but not clinically. In each case, however, no treatment was indicated.

RADIOLUCENT ENTITIES:

Cysts

Only one cyst was detected radiographically. There was no clinical evidence for it. It was found in the UR 3 radicular region of a 61 year old woman. It was well circumscribed and small in size (5 mm. diameter). It would seem to be a residual cyst and treatment was not indicated. (see Radiograph #9).

ANATOMICAL VARIANTS

Table VIII shows these entities. It can be seen that exostoses are frequently difficult to see in panoramic films.

Table VIII - Anatomical Variants

	Viewed Clinically	Viewed Radiographically
Radiopacities		
Exostoses	20	4
* Other	-	2
Radiolucencies		
Exaggerated Mental Fossa	-	2
Exaggerated Submandibular Fossa	-	1
# Other	-	2

* Includes dense exaggerated mental protuberance, and exaggerated posterior-mandibular ramus.

Includes resorbed condylar heads, thinning of an area of bone in the ramus.

Of the exostoses; taurus palatinus (4), taurus mandibularis (6), maxillary buccal exostoses (10). The majority (65%) were found in males and in only one case was surgical reduction required.

The anatomically variant radiolucent areas have no clinical significance.

JAW ARCHITECTURE:

Normal and abnormal features associated with the denture bearing areas were examined clinically and radiographically.. The results of these comparisons are shown in Table IX.

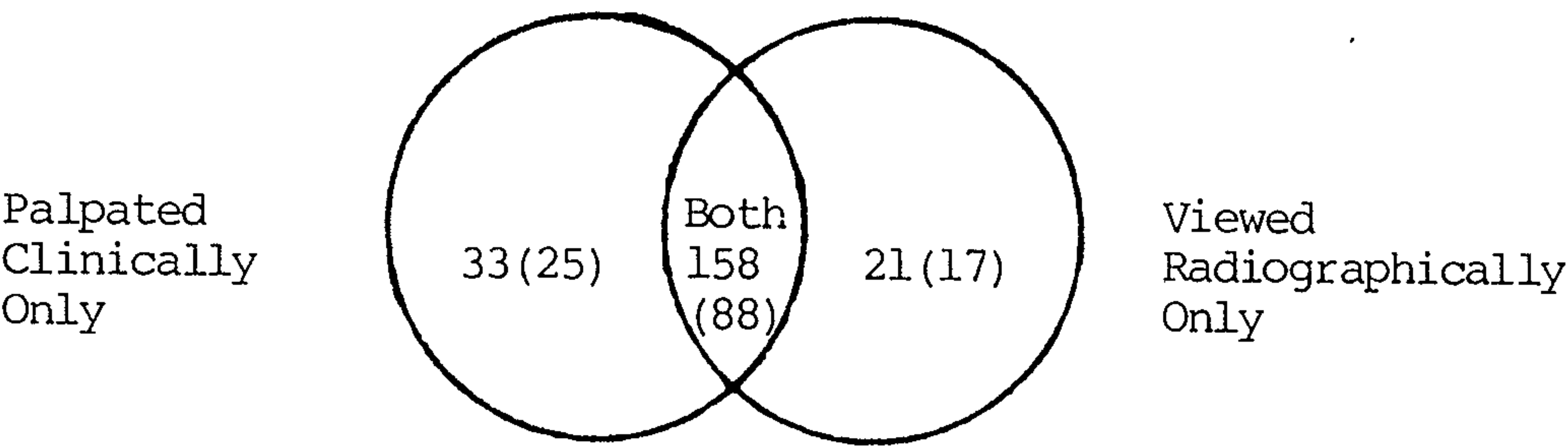
Table IX - Jaw Architecture

Age n	< 40 12	40-59 72	60-69 124	≥ 70 92
<u>Clinical Findings:</u>				
Mental Foramen on Alveolar Ridge	2(1)	28(15)	86(50)	75(56)
Mucosal Hyperplasia	2	20	40	33
Misc. Pathology	-	10	19	7
Ridge Irregularities	2	16	28	14
Ridge Thickness 5-10 mm	-	2(1)	9(5)	9(5)
11-15 mm	2(1)	16(8)	47(24)	34(18)
15 mm	-	-	-	-
Antrum Associated with ridge	-	-	-	-
Abnormal trabeculae pattern	-	-	-	-
<u>Radiographic Findings:</u>				
Mental Foramen on Alveolar Ridge	1(1)	26(15)	94(55)	63(36)
Mucosal Hyperplasia	-	7	6	6
Misc. Pathology	-	-	-	-
Ridge Irregularities	4	12	16	11
Ridge Thickness 5-10 mm	-	-	10(6)	8(4)
11-15 mm	2(1)	12(6)	36(21)	27(18)
16-20 mm	-	4(2)	18(11)	10(7)
Antrum Associated with ridge	3(2)	24(15)	37(22)	18(14)
Abnormal trabeculae pattern	-	3	2	2

a) Position of Mental Foramen.

The mental foramen was palpated as a depression on the alveolar ridge or viewed radiographically as such. Figure 3 gives an indication of the likelihood that a mental foramen on the ridge will be detected by both methods. Of those observed in both methods; there were 41 instances in (23) male patients and 117 instances in (65) female patients.

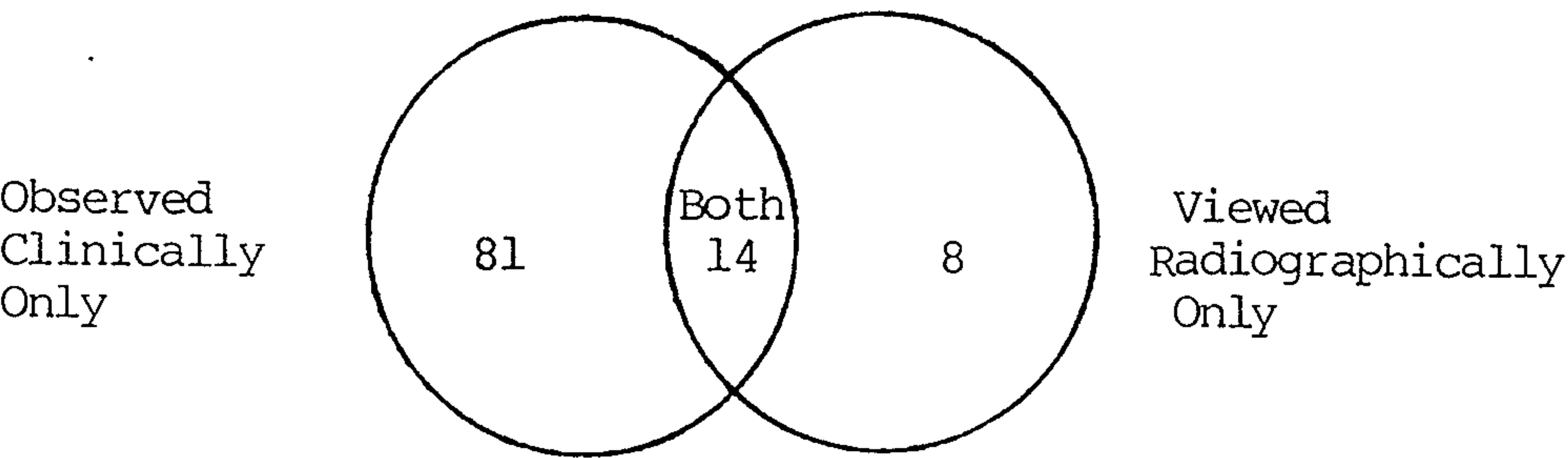
Figure 3:



b) Mucosal Hyperplasia.

Similarly, Figure 4, gives a comparison between the two diagnostic methods.

Figure 4:



Many more cases were observed clinically. There was an even distribution between both sexes and jaws.

c) Miscellaneous Mucosal Pathology.

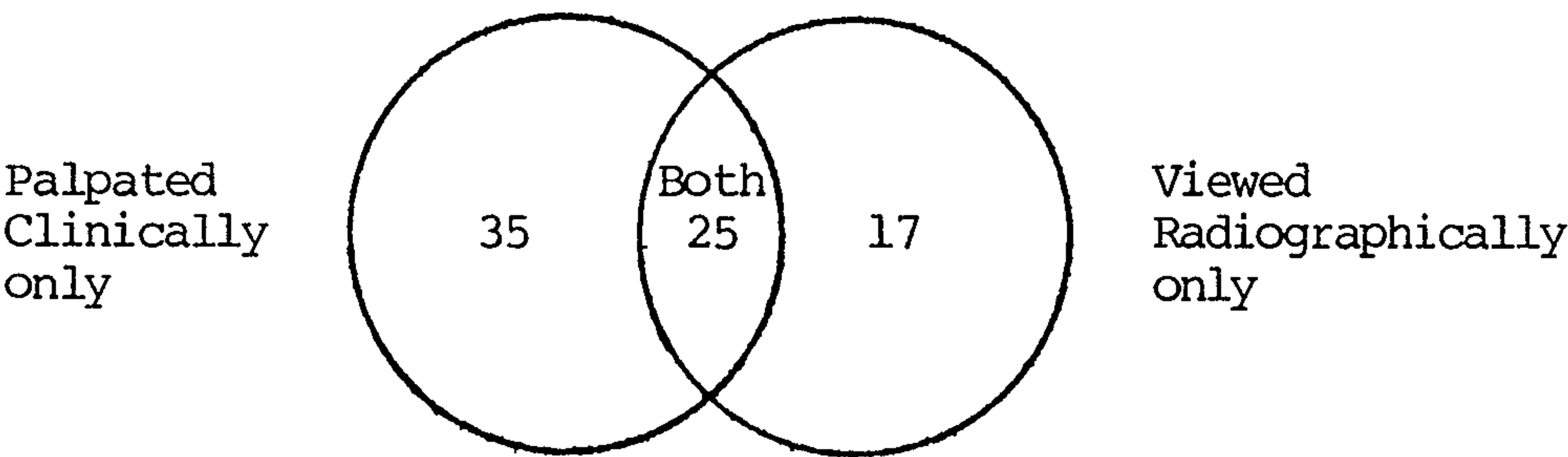
These include ulceration, leukoplakia, discharge, fistulas, inflamed areas, stomatitis, papilloma. There were 36 instances observed clinically only.

d) Ridge Irregularities (resorptive irregularity)

Figure 5 shows the comparison between radiographic and clinical findings. There was an even distribution between jaws. However,

males (32.1%) had a higher incidence than females (22.0%).

Figure 5:



e) Ridge Thickness

Table X lists the comparison in findings.

Table X - Ridge Thickness

	Clinical	Radiographic
5-10 mm	20 (11)	18 (10)
11-15 mm	99 (51)	77 (46)
16-20 mm	-	32 (22)

N.B. Ridges were not recorded clinically unless they were
 > 15 mm thick.

The totals of radiographic and clinical recordings roughly approximate each other despite not recording 16-20 mm thicknesses clinically. These results may indicate vertical magnification in the orthopantomograph.

f) Antrum Positioned On Alveolar Ridge

Radiographically, (82) instances in 53 patients were detected, but obviously were not seen clinically. This represents an overall figure of (17.7%) where the inferior border of at least one maxillary sinus extended to the maxillary alveolar ridge with little dense bony support in that region.

g) Abnormal Bony Trabeculae Pattern

There was found radiographically seven instances of abnormally coarse or fine trabeculae patterns, prominent and multiple nutrient canals, etc. (See Radiograph #10).

STATEMENT BY AGE GROUPS OF NEED FOR TREATMENT:TABLE XI

Age	n	Total No. of Pathological Findings of those detected radiographically but not clinically.	No. of Lesions which required treatment	Treatment Undecided.
< 40	12	3	0	0
40-59	72	56	2	5
60-69	124	79	0	2
≥ 70	92	72	1	0
TOTAL	300	210	3	7

N.B. Pathological findings include: Cysts, Retained Roots, Retained Teeth, Osteosclerosis, Soft Tissue Calcifications, Foreign Bodies, Exostoses.

This statement shows the higher number of pathological findings perpatient in older age groups but also the little likelihood that these will need treatment.

STATEMENT BY REASON FOR ATTENDANCE FOR PATHOLOGICAL FINDINGS

TABLE XII

	n	Cysts	Retained Roots	Retained Teeth	Osteosclerosis	Foreign Bodies	Exostoses	Soft Tissue Calcifications	Total No. of Findings.
New F/F	25	0	18	0	0	0	4	7	29
Renew F/F	208	1	#*34	4	30	3	12	110	194
Denture Pain	56	0	12	5	7	5	3	19	51
Miscellaneous	18 (7)	0	4	1 (1)	3 (1)	2 (1)	2 (1)	8 (6)	20 (10)
Total	307 (7)	1	68	10 (1)	40 (1)	10 (1)	21 (1)	154 (6)	294 (10)

N.B. Circled numbers denote those findings in the joint (Miscellaneous Plus Denture Pain) category.

denotes (3) pathological findings which required treatment

* denotes treatment undecided for (7) pathological findings.

No significant findings can be gleaned from this relationship. However, for those (25) patients requiring new F/F there were 29 pathological findings, the bulk of which were retained roots. Those patients needing to renew their dentures were the largest category and thus represented the bulk of the pathological findings. Soft tissue calcifications, osteosclerosis, retained roots and exostoses, were highest in prevalence in this category. In fact, the only pathological entities which either required treatment or in which treatment was undecided were found in this group. Those (56) patients complaining of denture pain had a high proportion of retained roots and retained teeth amongst their (51) observed findings. The (18) patients grouped in the miscellaneous category had no specific prevalence features.

Discussion:

A great deal of money is spent in performing routine panoramic radiography on edentulous patients prior to full denture construction. It is estimated at the United Dental Hospital, Sydney alone, \$8,000 per annum is spent on this aspect of patient care.

With due regard to the current concepts in treatment alternatives for the types of pathoses found in the jaws and adjacent dento-facial structures, and bearing in mind the prevalence of such conditions in this study and in other previous surveys, there seems little value in routine pantomographic use in the edentulous population. The results of this study are adequate evidence to support this conclusion. More emphasis must be placed on thorough clinical assessment as this is paramount for diagnostic success.

The results of the present study will be reviewed with specific reference to the importance of the pathological conditions found and to the re-statement of workable criteria for selection of patients for pantomographic screening.

The Survey Group:

Although the survey population was reasonably small (300 patients), the patients were selected randomly and give a good indication of the type of edentulous person seeking denture service at this hospital. Obviously, a small sampling decreases the chances of radiographically detecting the rare lesions that may necessitate immediate treatment, but this in itself supports the view above, re proper clinic evaluation. Surely, even 300 radiographs to find two cases where the treatment plan had to be altered, is extravagant, let alone 1.5×10^6 radiographs in order to find a life threatening lesion which may already be obvious clinically, e.g. osteogenic sarcoma ⁴².

The "Reason for Attendance" question was asked in order to observe whether there was a predilection for pathological disorders according to this aspect of history taking and one might assume that patients complaining of mouth ulcers or denture pain may have a higher likelihood of residual pathoses in the jaws causing these symptoms. While there was no significant difference between the total number of pathological findings and the reason for attendance, there were some discrepancies on an individual level.

Patients requiring new F/F dentures seem to have a greater than average number of retained roots compared with patients requiring renewal of F/F dentures.

The only 3 pathological conditions which altered the patients' treatment were all found in patients wishing to renew their dentures. This contradicts the view that any new pathological entity may be suggested by denture pain or some complaint found during history taking.

Those patients, however, who complained of denture pain, had a greater than expected number of retained teeth and foreign bodies. It is doubtful though, that a correlation can be drawn here in view of the small number of entities detected overall.

There were no significant findings on the number of abnormalities, for those patients with a variety of miscellaneous complaints.

In the study, (4%) of patients had previous oral surgical treatment. It was assumed that these patients would previously have had complete radiographic examination and thus no further abnormalities would be found. This certainly was the case and it seems likely that this type of patient does not require any radiographic screening unless there is a clinical indication for it.

The Radiograph

The reliability of the orthopantomograph for use as a screening implement is severely questioned by the results of this survey. The relative advantages and disadvantages of the use of panoramic radiography (and specifically orthopantomographs) have been discussed previously, 15, 16, 19-22, 25, 33, 36, 38, 43, 45, 46.

In view of the fact that 54 percent of the radiographs in this study were undiagnostic in some region (principally the anterior maxilla and anterior mandible), one must conclude that their use in a screening role without anterior intraoral periapicals, would be unsatisfactory²², despite the consensus of opinion in the literature that they are the most diagnostically accurate form of pantomograph available^{25, 38, 45}.

However, if there is a clinical indication for radiographic assessment, the dentist obviously suspects something in a specified area

of the jaws or related dento-facial areas, and therefore can choose an intraoral film or panoramic view of the area, or both, for best results. Furthermore, most pathological conditions observed in panoramic screening needed further intraoral investigation, before surgical treatment could be commenced ³⁷.

There is a generally accepted opinion that the orthopantomograph is extremely valuable in decision making for denture construction, i.e. it gives an analysis of the jaw architecture ³⁶. This will be discussed fully later.

Retained Roots:

The detection of retained roots and their need for treatment is discussed here, since they represent the only findings which required a change of treatment plan after radiographic examination. This weighing up of views is imperative in making a judgement for radiographs as a diagnostic aid in a particular patient.

The observation that 12% of patients had one or more retained roots is much less than previously reviewed edentulous surveys. The fact that over half the retained roots were detected radiographically and not observed clinically supports Scandrett's ²⁶ view that there are now less retained roots in recent edentulous surveys because a) the increased use of radiography b) increased diagnostic ability of the radiographs themselves and of those who interpret them c) more oral surgeons d) increased level of General Practitioner skill (especially in analysing jaws prior to full denture construction).

(The literature ¹² quotes the high incidence of retained roots as a reason for routine radiographic screening but one must question how many of those could be viewed clinically and how many that were missed clinically, according to the current concepts, would require treatment).

There were certainly more retained roots in the 40-59 age group than would be expected from their population. However, this discrepancy may be accounted for when the actual number of patients with one or more retained roots is tabulated.

8.3% of patients < 40 had retained roots
16.7% of patients between 40-59 had retained roots
11.3% of patients between 60-69 had retained roots
9.8% of patients > 70 had retained roots.

It is significant that the majority of patients (88%) had no retained roots and only (0.7%) of patients required definite treatment after their pathoses had been missed clinically.

The guidelines set by Helsham¹¹ have gradually been refined²¹⁻²³, to establish the current concept of treatment options for retained roots. These concepts are as follows: they should be removed if a) in areas of complaint (pain) b) if associated with a radiolucency c) if superficially located and likely to become exposed to the mouth (if occupying a superficial submucosal position following progressive alveolar ridge resorption.³⁶). It is apparent that in the absence of clinical and roentgenographic abnormalities, the retained root can be regarded as having been completely accepted by the tissues.²⁹ One survey quotes as four times, the probability of radiolucency associated with a root exposed to the oral cavity (usually due to carious breakdown) than those enclosed within bone (usually caused by improper extraction)¹². This emphasizes the fact that most problematical retained roots are not those which can only be detected radiographically (those which are buried) and supports the view that thorough clinical palpation and observance of fistulas is extremely important. Then, knowing the exact site of a retained root is usually of great advantage before surgical intervention, and the radiograph is then a necessity.

There is general agreement that radiopacities associated with retained roots are innocuous and do not require treatment^{18, 29, 30}.

What is the situation if retained roots are missed on clinical examination? At some stage, perhaps not at all, they would come to the surface and cause mild aggravation. At this time, the patients would complain of persistent ulceration and the root would be removed without altering the denture fit. However, one must concede that some roots may be missed which had an enlarging radicular cyst, which while not life threatening could erode valuable bone needed for denture success. Based on the results in this survey, the probability would be approximately 1 in 10⁵ only, provided a thorough and clinical examination were carried out.

The distribution of retained roots is similar to that in previous studies. They all report higher prevalence in the maxilla, especially in the region of multirooted teeth ^{21, 23, 38}. This appears to be due to poor visibility, root divergence, absence of radiographic aids, hesitancy in probing near the maxillary sinus and to poor technique (e.g. difficulty in extraction of UR4 due to back handed movements by right handed dentists). (see Radiograph #1).

Retained Teeth:

The prevalence of 2.3% for retained teeth is also lower than reported in other similar surveys, ^{1-3, 5-9, 18, 21-23}.

All 9 retained teeth were found in (7) patients over 60 years of age. However, this group also represent 72% of the survey population. The significant result is that 97.7% of edentulous patients have no retained teeth. Only 2 teeth were missed on clinical assessment. Because no teeth required treatment that were not detected clinically and no teeth had evidence of an associated radiolucency, it does not mean that this does not occur occasionally. However, the probability is very low. Similar guidelines should be established as for retained roots, taking into account the potential for more serious sequelae of ameloblastic change of a dentigerous cyst. However, Goaz & White ^{40.C.} state that ameloblastic change is quite rare and usually occurs before the age of 50. In an edentulous population where there is even less probability of the occurrence of dentigerous cysts ^{13, 19}, the likelihood of ameloblastic change would be very slight.

In spite of this low probability, many surveys have advocated routine screening based upon the need to detect the manifestations of the ameloblastoma. Treatment decisions related to ameloblastomas have progressed from routine removal of impacted teeth ⁵ to the current concept of observation of the tooth periodically to detect any of the removal criteria as follows; viz. if the tooth is a) partially erupted b) showing signs of resorption c) showing signs of cystic degeneration d) painful ^{13, 14, 23}. Removal of the tooth should be weighed against the likelihood of ankylosis of the tooth in the aged, the reduction of physical strength of the mandible after removal, and the fact that older patients may not tolerate the procedure as well as younger ones ²¹.

It appears that the value of radiography should not necessarily be in the detection of the retained tooth as this would be an extravagance, but in confirming clinical diagnosis and for periodic observation of the tooth. In this case panoramic radiographs would not offer the definition required for accurate assessment.

Calcifications, Ossifications and Miscellaneous Radiopacities:

The fact that all these entities were asymptomatic and did not require treatment is the most indicting comment against the use of panoramic radiographs for the detection of these pathoses. The prevalence of these entities compared with other surveys, may make interesting reading but they are purely 'documentary'.

Residual osteosclerotic areas were present in 12.3% of patients, with an even distribution between the jaws. The hypertrophic response of bone results from either a reaction to infection at the root apex (chronic focal sclerosing osteomyelitis) or a reaction to continuous occlusal load.

Stylohyoid ligament ossification was present in 15.3% of individuals, (see Radiograph #4) but has variable prevalence³⁸ and usually has no clinical significance¹⁴. A variety of studies^{21, 30, 39}, have described it as being a variable elongation of the styloid process, which may completely ossify and project into soft tissue regions causing vague or sometimes obvious symptoms (neck pain, especially on the paths of the internal and external carotid arteries; dysphagia; headache; sore throat; or a feeling of an object in the throat). However, its symptoms must not be confused with those of neuralgia or TMJ problems³⁹.

Ectopic calcifications were present in 8% of individuals (see Radiograph #5). However, panoramic radiographs do not enable us to differentiate between the various pathoses in the region of the ramus of the mandible³⁷. They could represent calcifications of the salivary glands, muscle, skin or lymph nodes^{16, 30}; or could be phleboliths, residual radiopaque contrast medium from previous sialography or osteophytic projections from the ramus¹⁴. All such entities are benign³⁴.

Antroliths were present in 2.7% of the survey population; (see Radiograph #6); a figure which greatly exceeds the opinions of other

researchers ⁴⁴. Mucous stagnates in sites of previous inflammation, (root fragments, bone chips or foreign objects) and calcifies. These asymptomatic calcareous bodies are not very radiopaque, have no evidence of root canal morphology, but have evidence of trabeculation (lamination), and they are of variable density and outline and are usually attached to the sinus wall (thus not moving during tube shift) ^{40.B}.

Mucous Retention Phenomena was found in over 1% of patients. The condition is a well delineated, dome shaped, broad based entity, arising from the sinus floor and has a convex free margin ^{27, 31}, (see Radiograph #7). Surveys of dentate subjects have reported higher figures ^{16, 27}, and this is explained by the observation that 89% of these phenomena are associated with odontogenic pathosis. They are rarely symptomatic and may spontaneously resolve. They should not be confused with polyps or mucocoeles.

Panoramic radiographs should only be used for detection of these entities when there is a specific indication to do so, e.g. symptoms of Eagle's syndrome, patients with sinusitis or associated antral symptoms.

Foreign Bodies:

These are usually amalgam fragments and as such are usually asymptomatic. The prevalence of 3% is comparable to other surveys ^{5, 6, 9}, and only on one occasion was the entity missed on clinical examination. It is unlikely that this debris becomes infected and removal is only indicated if it is easily accessible and is causing problems in denture construction ²³.

Radiolucent Entities:

These cysts and similar abnormalities causing bone destruction can be regarded as the most sinister group of pathoses detected in the jaws. The observation of only one small residual cyst points to the fact that these radiolucent lesions are very rare in the edentulous population. Indeed, this lesion was diagnosed to be totally harmless (see Radiograph #9). However, one cannot ignore the possibility of early detection of an ameloblastoma, osteogenic sarcoma or central malignancy of bone, therefore allowing the surgeon a less radical

surgical procedure than would have occurred if we waited for the clinical manifestations to present themselves. The problem is that all of these sinister radiolucencies are so rare, that in terms of radiation exposure, and cost-benefit analysis, it would seem unnecessary for this type of screening.

Anatomical Variants:

Because the focal trough of the panoramic machine may miss areas of bone, many of the exostoses were not seen radiographically. Indeed, a clinical examination should be able to detect exostoses and an assessment of its effect on denture construction with a view to surgical reduction, can instantly be made without radiographs.

Jaw Architecture:

Many articles stress the importance of analysing the bony foundation both clinically and radiographically before commencing full denture construction. One author suggests panoramic radiographs are useful in determining bone density, alveolar ridge regularity, vertical bone height, the locations of canals and foramina and the vertical dimension both before and after treatment¹⁷. Boucher³⁶ expounds on these suggestions by stating the quality of bone is important in supporting the dentures (denser bone has a better foundation and less likelihood for rapid change in the basal seat when dentures are worn); that the detection of sharp spicules of bone on the ridge effects decisions like the location of the occlusal plane, types of impression materials and the design of the denture base; and the thickness of submucosa covering bone can be detected radiographically.

Certainly, some of the radiographic observations are very illuminating, but it is doubtful if the average dentist would alter the way he manufactured the dentures.

The position of the mental foramen on the alveolar ridge was detected frequently (75%), both clinically and radiographically. Atrophy of the mandible is common and the exact location of the mental foramen is necessary⁴⁴, in view of the compressive forces exerted during denture wear. The results demonstrate that simple palpation of the

mandibular ridge nearly always can detect the position of the mental foramen. There was an expected increase in detection on the ridge of the mental foramen with increasing age.

Areas of mucosal hyperplasia were found to be common (34%). Obviously, they are more evident clinically unless the radiograph is under-exposed.

Likewise, miscellaneous mucosal pathology could only be observed clinically.

Resorptive irregularities are not always seen both clinically and radiographically. Many were only viewed radiographically and many more only palpated clinically. Thick, hyperplastic mucosa may restrict clinical observation of these irregularities.

The comparison of mandibular ridge thickness was basically an exercise in quantifying the thickness. There were higher thickness values overall for the radiographic assessment, probably solely due to radiographic magnification. Obviously ridge thickness decreased with age. It is recognized that a heavily resorbed jaw and its implications can be distinctly assessed by clinical evaluation.

However, the position of the antrum cannot be assessed by clinical examination. Radiographs detected 17.7% of patients with 1 or more antrum extending onto the maxillary alveolar ridge. Because of this limited dense bony support, denture manufacture must avoid placing too much load on this area ³⁵.

Additionally, there were 7 instances of abnormal trabeculae pattern including several multiple nutrient canals, which when without an overlying layer of compact bone, may result in further rapid resorption ²³. An osteomyelitic-like trabeculae pattern can be observed in Radiograph #10.

Because so few occult lesions which were missed during clinical examination required treatment, there was very little likelihood of detecting an age distribution pattern for these lesions.

It seems obvious that for the patients of the kind selected in this study, the use of screening films does not appear to be a beneficial use of radiation and the practice should be discontinued. The use of sensible selection criteria and professional judgement for

radiographs after a thorough clinical examination and history taking would eliminate much of the unnecessary radiation whilst not decreasing the valuable diagnostic yield from routine panoramic radiographs.

Concurrently, a critical assessment must be made of the benefit that the patients will derive versus the potential risk to their health (especially if they have a history of previous exposure to ionizing radiation).

Selection Criteria for Panoramic Radiography of Edentulous Patients:

The combinations of patient signs, symptoms, history, demographic and clinical characteristics were assessed to see which were predictive of patients for whom panoramic radiography influenced patient treatment. As a consequence, it was hoped to be able to drastically decrease radiation exposure without substantially decreasing our diagnostic yield.

Criteria: The following are recommended guidelines which indicate the need for radiographic examination.

- (i) A patient with pain related to the jaws which cannot be accounted for by clinical examination.
- (ii) When a retained root or tooth is palpated clinically (i.e. the x-ray is confirmatory).
- (iii) When the examiner is unsure of his diagnosis.
- (iv) When periodic review is indicated for a retained root or tooth.
- (v) When there are specific clinical indications or symptoms then panoramic radiographs may visualise the asymptomatic 'documentary' oro-facial pathoses.
- (vi) For patients with advanced resorption or irregular ridges in which radiographic evidence could effect the type of denture treatment.
- (vii) When there is any degree of cortical expansion or swelling related to bony tissue.
- (viii) For problems which prevent proper clinical examination, e.g. trismus, Hepatitis B, AIDS, severe gagging, spasticity, Parkinson's Disease.

Because the pantomograph frequently is undiagnostic in the anterior region, it is often necessary to use periapical films alone in the above instances, especially in view of their low radiation exposure. However, when the dentist requires a film to show an overall view of the jaws and associated structures, or when a lesion is suspected to be larger than the coverage of an intraoral film, a panoramic radiograph, or an occlusal view, is indicated.

Additionally, the dentist must use his discretion or refrain from radiographic screening in the following clinical situations:

- (i) For women of child bearing age, unless the benefit of the examination is essential to the diagnostic or treatment success.
- (ii) For edentulous subjects who have had previous oral surgical treatment, unless there is some clinical manifestation.
This group is unlikely to have anything further wrong with them.
- (iii) For teaching or patient education purposes.

CONCLUSIONS:

Panoramic radiographic screening of 300 edentulous patients at the United Dental Hospital, Sydney, yielded 210 pathological lesions of dento-facial origin which were not detected by thorough clinical examination and history taking. However, only three retained roots in two patients altered the treatment decision and these in fact were harmless entities. The bulk of the pathoses detected were purely 'documentary' and of no clinical significance. Radiographic investigation for these entities must only be carried out if there is a specific clinical or historical indication.

The prevalence of the pathoses observed in this survey population is as follows: Retained roots 12% (11.8% of these had associated radiolucencies), retained teeth 2.3% (none had associated radiolucencies), Osteosclerosis 12.3%, Stylohyoid Ligament Ossification 15.3%, Ectopic calcifications 8%, Exostoses 6.7%, Antroliths 2.3%, Mucous Retention Phenomena 1.3%, Foreign Bodies 3%, plus one residual cyst. They have little significance when related to the patients' age or their reason for attendance. Although a higher number of pathological findings were detected radiographically but not clinically in the older age groups, these mainly represented calcifications which were asymptomatic and required no treatment.

Apart from the very few significant findings, the value of the screening process was further eroded by the inadequacy of the orthopantomograph 5, which is widely considered the best type of pantomographic unit. Fifty-four percent of orthopantomographs were judged to have undiagnostic regions, especially in the anterior maxilla (48.7%) and anterior mandible (22.3%).

Unless there are specific indications for the use of orthopantomographs (see selection criteria), single periapical films in most instances would suffice, after clinical evidence has indicated the need for radiographic assessment.

However, for the conscientious dentist, the panoramic radiograph gives a good understanding of the jaw architecture, prior to full denture construction, i.e. in terms of bone density, alveolar ridge resorption, vertical bone height, locations of canals and foramina, vertical dimension (before and after treatment) and the ability of the bony foundation to accept occlusal load which may effect treatment decisions in denture manufacture.

The whole question of screening and selection criteria has been raised again in this study. How reasonable is it to expose patients for only a slight probability of detection of urgent conditions which require treatment? The risk versus benefit ratio must be assessed using professional judgement and employing selective radiography as the dentists' tool. When panoramic radiographs are taken for any specific indication, particularly when no other radiographs are obtained, the yield of positive findings is high.

Panoramic radiographs must never be used as a screening examination

- a) when they are not expected to add any new information
- b) when judged of doubtful importance diagnostically
- c) when supplemental to a full mouth series
- d) when routinely performed during an initial examination or recall examination
- e) when the need for other specific types of radiographic examination is not yet determined
- f) when used to assess the acceptability of the patient for teaching purposes
- g) when used as a defence against malpractice, and
- h) totally unjustified when taken prior to a clinical examination (including dental, oral, medical aspects as well as past radiation history) and not based on these findings.

It is conceivable that an over reliance on panoramic radiography may lead in some instances to an undermining of thorough clinical examination and treatment planning, rather than its enhancement. Reliance, however, on clinical indications is a safe, effective method of selecting radiographs appropriate to the patients' needs.

For the patients of the kind selected in this study, the use of screening films does not appear to be a beneficial use of radiation and it is recommended that the practice be discontinued.

BIBLIOGRAPHY

1. Cook, T.J. Statistics Obtained by Clinical & Roentgenographic Examination of 500 Edentulous and Partially Edentulous Mouths.
Dental Cosmos, 69:349-351, 1927
2. Cheppe, E. Tabulation and Analysis of Results of Xray Examination of Edentulous Mouths. Northwest University, Dent.Res.Grad.Quart Bull., 36:12-15, 1936
3. Waggener, R.W. Austin, L.T. Dental Structures Remaining in 1948 Edentulous Jaws: A Statistical Survey.
JADA, 28:1855-1857, 1941.
4. Swenson, H.M. Roentgenographic Examination of the Edentulous Mouth.
JADA, 31:475-487, 1944
5. Smith, E.S. Findings in the Roentgenograms of Edentulous Patients.
JADA, 33:584-587, 1946
6. Ennis, L.M. Berry, H.M. Jr. Necessity for Routine Roentgenographic Examination of the Edentulous Patient.
J.Oral Surg., 7:3-19, 1949
7. Edwards, R.W. Roentgenographic Study of Edentulous Jaws.
J.Dent.Res., 30:504-505, 1951
8. Storer, R. A Radiographic Survey of Edentulous Mouths.
Brit.Dent.J., 103:344-347, 1957
9. Crandell, C.E. Roentgenographic Examination of Edentulous Jaws.
J.Pros.Dent., 9:552-554, 1959
10. Crandell, C.E. Trueblood, S.N. Chapel-Hill, N.C. Roentgenographic Findings in Edentulous Areas.
J.Oral Surg., 13:1343-1348, 1960
11. Helsham, R.W. Some Observations On the Subject Of Roots of Teeth Retained In The Jaws As a Result of Incomplete Exodonture.
Aust.Dent.J., 5:70-77, 1960
12. Dachi, S.F. Howell, F.V. A Survey of 3874 Routine Full Mouth Radiographs 1. A Study of Retained Roots and Teeth.
J.Oral Surg., 14:916-924, 1961
13. Dachi, S.F. Howell, F.V. A Survey of 3874 Routine Full Mouth Radiographs 11. A Study of Impacted Teeth.
J.Oral Surg., 14:1165-1169, 1961
14. Lilley, G.E. Steiner, M. Irby, W.B. Oral Health Evaluation: Analysis of Radiographic Findings.
JADA, 71:635-639, 1965
15. Updegrave, W.J. The Role of Panoramic Radiography in Diagnosis.
J.Oral Surg., 22:49-57, 1966

16. Christen, A.G.
Meffert, R.M.
Cornyn, J.
Tiecke, R.W. Oral Health of Dentists: Analysis of
Panoramic Radiographic Survey.
JADA, 75:1167-1168, 1967
17. Thorpe, J.O. Panoramic Radiography In The General Practise
of Dentistry.
J.Oral Surg., 24:781-792. 1967
18. Michaeli, Y.
Hermel, J.
Gizenfield, E.
Michman, J. Pathologic Radiographic Findings in Clinically
Symptom-Free Edentulous Subjects.
J.Oral Surg., 26:27-30, 1968
19. Morris, C.R.
Mareno, P.D.
Swimley, D.C.
Runco, J.G. Abnormalities Noted on Panoramic Radiographs.
J.Oral Surg., 28:772-783, 1969
20. Cuttino, C.L.
Pagozelski, D.S.
Richard, G.R.
Tiecke, R.W. Panoramic Radiographic Survey of Dentists:
Interpretation of Findings.
JADA, 79:1179-1182, 1969
21. Barclay, J.K.
Donaldson, K.I. Panoramic Radiography of the Edentulous Jaws -
A Survey of 100 Patients.
New Zealand Dent. J., 66:53-61, 1970
22. Bremner, V.A.
Grant, A.A. A Radiographic Survey of Edentulous Mouths.
Aust.Dent.J., 16:17-21, 1971
23. Ettinger, R.L. Roentgenographic Evaluation of the Edentulous
Patients.
Aust.Dent.J., 16:210-219, 1971
24. Rouse, C.W. Notes on the Interpretation of the Ortho-
pantomogram.
Brit.Dent.J., 130:425-434, 1971
25. Keith, D.A. The Detection of Abnormalities in the Jaws -
Survey.
Brit.Dent.J., 134:129-135, 1973
26. Scandrett, F.R.
Tebo, H.G.
Miller, J.T.
Quigley, M.B. Radiographic Examination of the Edentulous
Patient - Review of literature and preliminary
report comparing three methods.
J.Oral Surg., 35:266-274, 1973
27. Halstead Mucosal Cysts of the Maxillary Sinus - Report
of 75 cases.
JADA, 87:1435-1441, 1973
28. Weuhrmann
Manson-Hing. Dental Radiology
3rd Edition, 1973, St.Louis, C.V. Mosby Co.,
pp.192-194
29. Herd, J.R. The Retained Tooth Root
Aust.Dent.J., 18:125-131, 1973
30. Stafne Oral Roentgenographic Diagnosis.
3rd Edition, Philadelphia, 1975, Saunders Co.
pp.11-15

31. Ohba, T.
Manson-Hing, L.R. Radiological Study of Cyst-like Lesions in the Maxillary Sinus.
Dent.Max.-Facial Rad., 4:100-103, 1975
32. Hansen, B.F.
Johansen, J.R. Oral Roentgenologic Findings in a Norwegian Urban Population.
J.Oral Surg., 41:261-265, 1976
33. Frykholm, A.
Malmgren, O.
S  mfors, K.
Welander, U. Angular Measurements in Orthopantomography
Dent. Max-Facial Rad., 5:77-81, 1976
34. White, S.C.
Weissman, D.D. Relative Discernment of Lesions by Intraoral and Panoramic Radiography.
JADA, 95:1117-1121, 1977
35. Klineberg, I.,
et al. Complete Denture Construction: Clinical and Laboratory Procedure.
University of Sydney, Dept. of Pros.Dent., Sydney. 3rd Edition, pp. 1979
36. Boucher, C.O. Prosthodontic Treatment for Edentulous Patients. C.V. Mosby Co., St. Louis
Hickey, Zarb. 8th Ed. pp.68-70, 1980
37. Tronje, G.
Bolin, A.
Eliasson, S.
Julin, P. Panoramic Radiography of Edentulous Jaws.
1. Frequency and Distribution of Pathological Findings.
Dent.Max.-Facial Rad. 9:21-25, 1980
38. Alattar, M.M.
Baughman, R.A.
Collett, W.K. A Survey of Panoramic Radiographs for Evaluation of Normal and Pathologic Findings.
J.Oral Surg., 50:472-278, 1980
39. Winkler, S.
Sammartino, F.J.
Sammartino, F.J., Jr.
Morari, J.J. Stylohyoid Syndrome - Report of a Case.
J.Oral Surg., 51:215-217, 1981
- 40.A. Goaz, P.W.
White, S.C. Oral Radiology: Principles and Interpretation
C.V. Mosby Co., St. Louis, 1982. Ch.20.
- 40.B. Goaz, P.W.
White, S.C. Ditto p.625
- 40.C. Goaz, P.W.
White, S.C. Ditto pp.429, 468
41. Santangelo, M.V. Dental Radiology: Focus for the 1980's.
J.Dent.Educ., 46:97-103, 1982
42. Kogan, S.L.
Stephens, R.G. Selective Radiography Instead of Screening Pantomography: A Risk/Benefit Evaluation.
J.Can.Dent.A., 48:271-275, 1982
43. Muhammed, A.H.
Manson-Hing, L.R. A Comparison of Panoramic and Intraoral Radiographic Surveys In Evaluating a Dental Clinic Population.
J.Oral Surg., 54:108-117, 1982

44. Grenthe B. Maxillary Antroliths: Report of 2 New Cases
 Dahlberg J.Oral Surg., 57:273, 1984
45. Barrett, A.P. A Critical Evaluation of Panoramic
 Waters, B.E. Radiography As a Screening Procedure in Dental
 Griffiths, C.J. Practice.
 J.Oral Surg., 57:673-677, 1984
46. Lloyd, P.M. Periodic Oral Examinations and Panoramic
 Gambert, S.R. Radiographs in Edentulous Elderly Men.
 J.Oral Surg., 47:678-680, 1984
47. White, S.C. Patient Selection Criteria for Panoramic
 Forsythe, A.B. Radiography.
 Joseph, L.P. J.Oral Surg., 57:671-690, 1984

EXAMINATION RECORD

ES/1984

Name: Mrs. G. WINTER

Age: 67

Reg. No: 018855

Sex: F

Years Denture Wearing: Overall - 38 yrs, Current ones - 13 yrs.

Surgical Treatment: No

R.F.A.

New F/F

Renew F/F

Denture Pain

Misc.

(state)

Patient complains they are loose

Pathological Disease Related to Jaws. No.

ClinicalRadiographicMaxMandMaxMand

I. Denture Bearing Areas

- Mucosal Hyperplasia	ⓇⓁ retromolar region	✓✓	—			
- Mucosal inflammation/discharge		—	—			
- Mental F. on ridge	ⓇⓁ	N/A	✓✓			
- Stage of resorption	a) discontinuous b) well defined	— ✓	— ✓	a) discontinuous b) well defined		
- Stress bearing (state)	a) mand. thickness b) misc.	Ⓡ 15mm Ⓛ 10-15mm —	—	a) mand. thickness b) antrum position c) trabeculae		
II. Radiopacities						
- Retained roots UR4 - No associated inflammatory changes	a) exposed b) in soft tissue c) fistula	— ✓ —	— — —	a) tip b) fragment c) + r/opacity d) + r/lucency		
- Retained teeth	a) palpable b) + infection	— —	— —	a) unerupted b) impacted c) supernumery d) + r/lucency		
- Condensing osteitis		N/A	N/A			
- Exostoses		—	—			
- Calcifications (state)		—	—			
- Foreign bodies	LL6 - amalgam tattoo	—	✓			
- Miscellaneous (state)		—	—			
III. Radiolucencies						
- Anatomical variant		—	—			
- Cysts (state)	Cortical swelling	—	—	Well defined lucency		
- Unclassifiable bone defect		—	—			
- Miscellaneous (state)		—	—			

NB (state) = preliminary diagnosis

EXAMINATION RECORD

ES/1984

Name: Mr. L. DUNCAN

Age: 58

Reg. No: 039393

Sex: M.

Years Denture Wearing: Overall - 22 yrs, Current Ones - 4 yrs.

Surgical Treatment: No.

R.F.A.

New F/F

Renew F/F

Denture Pain

Misc.

(state)

Pathological Disease Related to Jaws. No. Patient complains of constant ulceration

OPG undiagnostic
in anterior
maxillary region.

Clinical

Radiographic

Max

Mand

Max

Mand

I. Denture Bearing Areas

- Mucosal Hyperplasia
- Mucosal inflammation/ discharge
- Mental F. on ridge
- Stage of resorption
- Stress bearing (state)

II. Radiopacities

- Retained roots
- Retained teeth
- Condensing osteitis
- Exostoses
- Calcifications(state)
- Foreign bodies
- Miscellaneous(state)

III. Radiolucencies

- Anatomical variant
- Cysts (state)
- Unclassifiable bone defect
- Miscellaneous (state)

	—	—
	—	—
(R)	N/A	✓
a) discontinuous	✓ ANT	—
b) well defined	✓	✓
a) mand. thickness	(R) 10mm (L) 10mm	10mm 15mm
b) antrum position	—	—
c) trabeculae	—	—
a) tip	—	—
b) fragment UR6 [#]	✓	—
c) + r/opacity	—	—
d) + r/lucency	—	—
a) unerupted	—	—
b) impacted LL8 [#]	—	✓
c) supernumery	—	—
d) + r/lucency	—	—
LL6	—	✓
(R) Ectopic Calcifications of ramus	—	—
(L) Stylohyoid Ossification	—	—
	—	—
	—	—
Well defined lucency	—	—
	—	—
	—	—

TREATMENT WAS
NOT NECESSARY

NB (state) = preliminary diagnosis

- IOGRAPH #1: MULTIPLE RETAINED ROOTS IN MAXILLA:
Some embedded, some in soft tissue. Some are fragments, some are tips.
Note Also: Miscellaneous opacity in (R) ramus region, and irregular bone in anterior mandible.
- IOGRAPH #2: SUPERNUMERY TEETH (MESIODENS)
Note Also: Prominence of inferior dental canal and the undiagnostic anterior mandible.
- IOGRAPH #3: UNERUPTED THIRD MOLAR (in (R) maxilla):
Note Also: The undiagnostic anterior mandible, multiple ectopic calcifications on the (L) ramus.
- IOGRAPH #4: STYLOHYOID LIGAMENT OSSIFICATION (bilateral):
Note Also: The undiagnostic anterior mandible and maxilla.
- IOGRAPH #5: MULTIPLE ECTOPIC CALCIFICATIONS (bilateral):
Note Also: Improper vertical positioning of patient, the undiagnostic anterior mandible and maxilla.
- IOGRAPH #6: ANTROLITHS (Bilateral, arising from floor of maxillary sinus):
Note Also: The undiagnostic anterior mandible.
- IOGRAPH #7: MUCCUS RETENTION PHENOMENA (in (R) sinus):
Note Also: Slight bilateral stylohyoid ligament ossification and undiagnostic anterior maxilla.
- IOGRAPH #8: LATERAL PTERYGOID CALCIFICATION (Bilateral):
Note Also: Retained root tip in UR3 region, mental foramen on (R) ridge, ectopic calcification on (L) ramus, undiagnostic anterior mandible and maxilla.
- IOGRAPH #9: RESIDUAL CYST:
Note the well corticated nature of it.
- IOGRAPH #10: ABNORMAL TRABECULAE PATTERN IN (R) MANDIBLE (almost osteomyelitic like):
Note Also: Retained root's UL3, 4, 5 region, amalgam fragments in LL5 region and undiagnostic anterior maxilla and the (R) half of the jaw.

PART 11:

TEMPOROMANDIBULAR JOINT ARTHROGRAPHY AND ASSOCIATED RADIOGRAPHIC
TECHNIQUES

- A REVIEW OF THE LITERATURE

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INTRODUCTION

From functional and anatomic points of view, the temporomandibular joint is one of the most important and unique joints of the body. The temporomandibular joints provide the only articulation between the lower jaw and the skull complex. There is an intimate relationship between the temporomandibular joints and the occluding dentition, the patients' stress states and other systemic manifestations. Any slight imbalance may upset the integrity of the joints. Though the joints have the capacity to adapt to an extent, a chronic untreated condition may bring about gross abnormalities in their function.

Many surveys have related the escalating incidence of temporomandibular joint syndrome (dysfunction) in the Western culture to the stress status of modern society. The diagnosis of temporomandibular pathology via radiographic visualisation and clinical means is therefore becoming increasingly important. The dysfunction itself and methods of diagnosis and treatment have gained prominent attention in clinical and scientific dental journals. Much of this current review is devoted to the interpretation of this literature.

More recently, a technique for introducing water soluble radiopaque contrast medium selectively into either temporomandibular synovial space, has been developed for the purpose of radiographic evaluation. This is termed arthrography. Arthrography employing tomography and other specialised techniques has superseded conventional radiography and has heralded a new approach for successful clinical management.

The idea of arthrography is not new. Its acceptance and widespread use is, however. According to many investigators, the first reference to the clinical application of temporomandibular joint arthrography was by Nørgaard in 1947, who described the arthrographic technique, its interpretation and methods of needle placement into joint spaces. This will long remain a work of reference on this subject. A hiatus existed until the late 1960's when its use became more or less accepted as a valid diagnostic aid. Much research has since been carried out and arthrographic methodology and interpretation have been further refined and consequently, its diagnostic value improved.

Even before the days of arthrographic acceptance, when conventional radiography was the only non-clinical assessment available, the popular school of thought suggested that no diagnosis of temporomandibular joint problems be attempted without the aid of radiography in instances where clinical symptoms existed. Indeed, arthrography has further motivated this opinion.

Arthrography of the temporomandibular joint is principally used in cases of pain and dysfunction (clicking, popping or locking joints). It is a valuable aid in the diagnosis of damage to the intra articular soft tissue (specifically internal temporomandibular disk derangement or disk perforation or both). Most researchers acknowledge the procedure as safe, effective, but technically difficult to perform. Interpretation requires skill and experience by observing the fundamental differences between normality and abnormality. For these reasons and combined with an evaluation of the risk versus benefit of such a procedure (some authors suggest there is a relatively high risk of aggravating existing joint conditions during arthrography), only strict indications should warrant its use. Some clinicians argue, however, that even if there is a negative finding, that this in fact indicates the procedure is valuable nonetheless in confirming a diagnosis.

With the development of arthrography of the temporomandibular joint, diagnosis has greatly improved. Clinical symptoms can accurately be correlated to the radiographic assessment to enable the formulation of a meaningful prognosis since we now know the existing joint condition. Successful management is then possible, though this often involves multifaceted treatment.

The objective of this review, is to assess the role of temporomandibular joint arthrography and associated radiographic techniques. Specifically, their uses, principles, diagnostic evaluation, and the findings of related studies will be reviewed and discussed with reference to the aetiological aspects of temporomandibular joint dysfunction.