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Soft Tissue-Spot-Tangential Roentgenography in Diagnosis of Thyroid Carcinoma —a Method for Detecting Psammoma Bodies¹⁾—

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軟 X 線, 狙撃切線, 撮影法による甲状腺癌とくに砂粒腫小体の診断

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1) 甲状腺癌特に乳頭腺癌にしばしば認められる, 砂粒腫小体を X 線学的に出すために, フアントム実験を行ない, 軟 X 線で 35 × 4.5 cm の円筒状のツープスによる狙撃切線撮影が微細な砂粒腫小体様陰影をよく出すことがわかった. 2) 過去 13 カ月にわたり主として甲状腺癌を疑わせる結節性甲状腺腫に対して, イ) 普通の頸部側方向像, ロ) 軟 X 線による頸部側方向像, および, ハ) 軟 X 線狙撃切線, 撮影の三撮影法を同時に施行し得た症例が 67 例におよんだ.

この三法を比較した結果(ハ)撮影法が砂粒腫小体様陰影を一番忠実に出すことがわかった.

組織学的に確定した 23 例の癌のうち, 砂粒腫様陰影を呈したのは 9 例であり, そのうち術前に臨

床所見上癌と確診し得たのは 1 例のみであり, 他の 8 例は臨床的には慢性甲状腺炎などのように非癌と診断されたものもあるが, 本撮影法による診断のみで癌と確診し得た.

砂粒腫小体様陰影を呈した症例は全例癌であり良性結節性腫瘍には 1 例も見られなかった. 3) 粗大石灰沈着は癌 23 例中 12 例に, 良性結節には 47 例中 13 例主に腺腫様甲状腺腫に見られたが粗大石灰沈着所見からは良性, 悪性の鑑別は容易でない.

ただし軟 X 線側方向像(ロ法)で濃厚な粗大石灰沈着が一カ所にかたまつて出現する時, 不規則な形をしたものが集つて出る時, 直径 1 cm 以下の輪状石灰沈着像の時は癌の可能性が多い.

Although the thyroid gland locates in the anterior neck readily accessible from outside and most of the disorders of the gland present some physical findings useful for a differential diagnosis, it is generally agreed that approximately one fourth or one third of patients with thyroid carcinomas cannot be diagnosed preoperatively. Recently attempts have been made to obtain more reliable and reproducible findings

by means of scintiscanning with radioiodine, selective angiography (Djindjian et al. 1964⁸⁾), laminagraphic examination of the neck after injection of gas into the soft tissues around the thyroid gland (Rozenshtaukh and Ponomarev 1964¹²⁾), ultrasound scanning (Fujimoto et al. 1967⁴⁾) and thyroid lymphography (Matoba and Kikuchi 1969¹¹⁾). All these techniques occasionally produce false positive as well as false negative results.

Roentgenographic examinations of the neck have widely been employed as part of the diagnostic procedures, but its real value would not be recognized in most institutions. The thyroid surgeons and pathologists are well aware of the diagnostic importance of the psammoma bodies in thyroid carcinomas. In our previous investigation (Fujimoto and Akisada 1970⁵⁾), the soft tissue roentgenography of excised specimens revealed psammomatous calcification in 59 of 100 cases of malignant thyroid neoplasms and only in two of 98 benign thyroid nodules. Several investigators (Segal et al. 1960¹³⁾); (Gasquet et al. 1963⁶⁾); (Margolin and Steinbach 1968¹⁰⁾); (Higuchi et al. 1969⁷⁾) have attempted to demonstrate psammoma bodies on the roentgenogram of the neck by a technique of soft tissue roentgenography. They all agreed that there were no false positive results, but even with this specific technique psammomatous calcification of insufficient number and density could not be identified on the roentgenogram in fairly large percentage of patients.

The current study was undertaken to promote the quality of soft tissue roentgenogram of the neck and to determine its usefulness in preoperative detection of thyroid carcinoma.

Phantom Study

As an initial step, in-vitro investigation was carried out in order to find out a method to demonstrate the intrathyroidal calcifications on roentgenograms of the neck in the highest quality now available with respects to the contrast, sharpness of detail and image resolution. Three paraffin-block specimens of surgically removed thyroid carcinomas known to contain either psammoma bodies or coarse calcific deposits were placed within a water phantom, which was made up of two plastic columns, both being glued to a bottom plate, thinner column being set up as a trachea within a wider column and the resulting cavity between two columns and the bottom being filled with water (Fig. 1).

After having performed several tests, we finally reached the conclusion that by the following technical factors the dense calcific deposits were most clearly defined and the faint psammomatous calcification was definitely identified on the roentgenogram. (a) The equipment is the same as routinely employed for soft tissue mammography. (b) The tube with its extension cone, which is round in cut surface, 4.5 cm in diameter and 35 cm in length, is angulated about 30 to 45 degrees toward the phantom in order to obtain tangential projection of the thyroid specimen. (c) The exposure factors are: 35-40 kVp, 150 ma, 1.5-2.0 sec., and 42 cm target-surface distance. (d) A fine grain, industrial film (Sakura X-Ray Film, Type MR) is used and processed manually.

Clinical Study

Materials and Methods

Since January, 1970, a soft tissue roentgenography of the neck was carried out for all patients with thyroid nodules or with signs and symptoms which would indicate the presence of occult carcinoma of

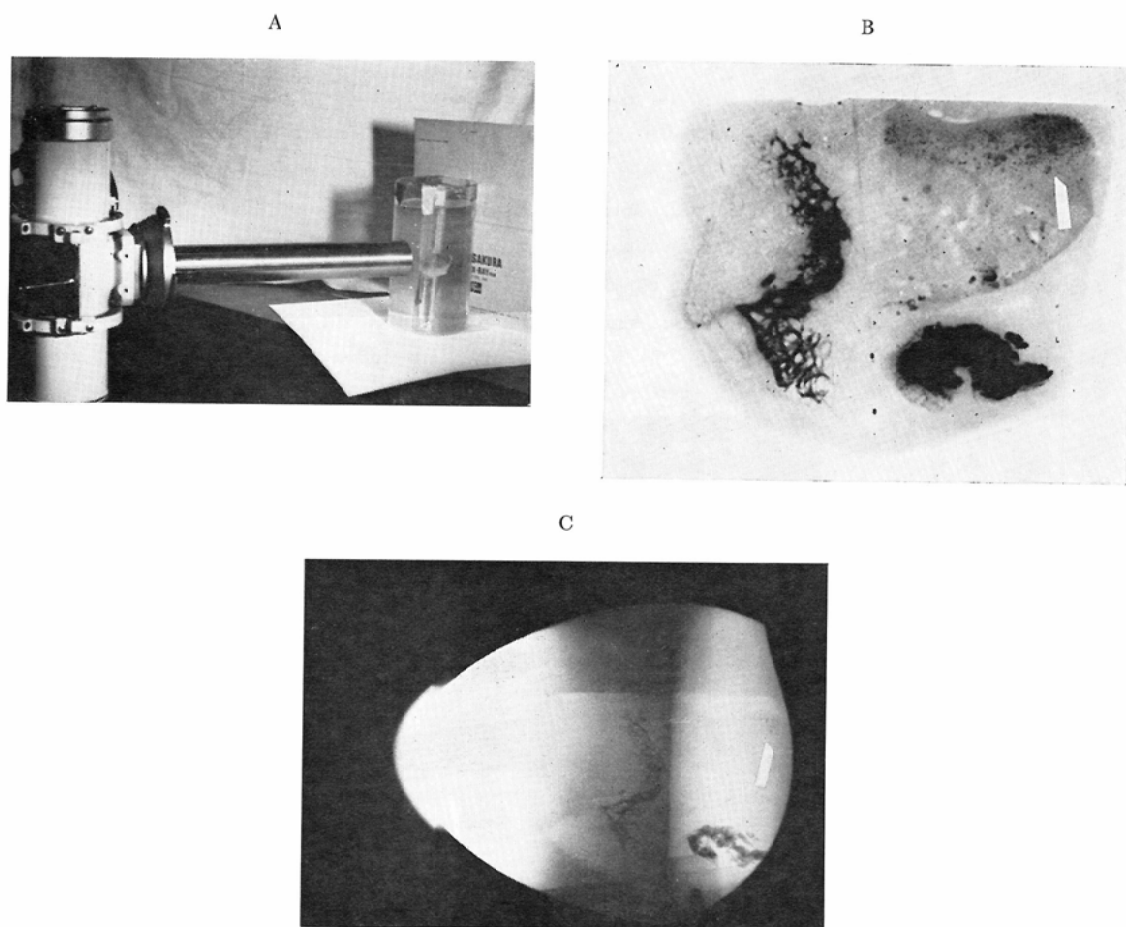


Fig. 1. (A) Water phantom for in-vitro investigation. (B) Soft tissue roentgenogram of three paraffin-block specimens known to contain coarse and psammomatous calcifications (←). The roentgenogram was taken before the specimens were set in the phantom. (C) Tangential view of the soft tissue, spot, roentgenograms of the paraffin block specimens in a water phantom.

the thyroid. The patients examined were those who visited the Out-Patient Clinic of the Second Department of Surgery and the roentgenograms were taken at the Department of Radiology, the University of Tokyo Hospital, usually on the day of their first visit. The selection of the patients for neck roentgenography was done by one of us (Y.F.) on the basis of the present history and the physical examination.

As for the patients with known toxic or nontoxic diffuse goiter and those with known subacute or chronic thyroiditis, roentgenograms of the neck were obtained in several instances at the early stage of this study. It became, however, soon apparent that no calcification was present in the thyroids affected merely by those diseases. Therefore, soft tissue roentgenogram of the neck was taken thereafter only when a patient was suspected clinically to have a nodule in association with the disease cited above.

During the period of 13 months until January, 1971, soft tissue roentgenograms of the neck were obtained in a total of 146 instances, of whom 70 were operated upon. For each instance three views

were regularly taken; one lateral view of soft tissue roentgenogram and two spot, tangential views of soft tissue roentgenogram of each side.

For the lateral view, the patient is placed in a lateral position on the roentgenographic table with the desired side downward and the pillow is inserted under the neck. A card-board cassette is inserted between the pillow and the neck. The exposure factors used for the average patients were: 42 cm target-surface distance, 45 kVp, 150 ma, 2.5 sec., non-screen industrial film and non-Bucky diaphragm.

The spot tangential view of soft tissue roentgenogram was obtained on both sides. Either the posterior oblique view with the patient in the semiprone position or the anterior oblique view with the patient in almost lateral position (Fig. 2) is taken, according to the location, size and shape of the thyroid nodule. The technical factors used were the same as those in the phantom study.

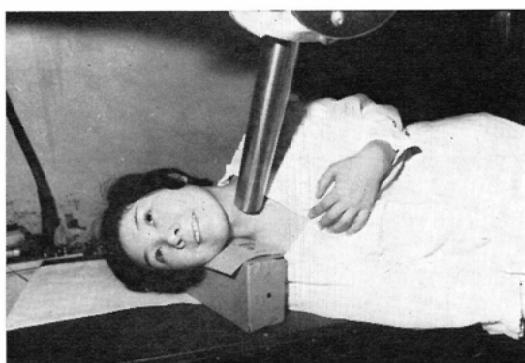


Fig. 2. Position of patient, film cassette and tube with its extension cone for tangential projection. In this case the right lobe of the thyroid is exposed.

In 67 instances, the lateral view of the ordinary roentgenogram of the neck was also taken with the equipment generally used for a conventional diagnostic roentgenography. The exposure factors are: 150 cm target-film distance, 65 kVp, 200 ma, and 0.1 sec. The medical x-ray film is used with the intensifying screen of type FS and Bucky-diaphragm 5:1.

After the operation, soft tissue roentgenograms of the surgically removed specimens were obtained using the same technique as had been applied in the previous study on the breast cancer specimens.²⁾

Results

Comparision of Three Types of Roentgenograms in Detectability of Intrathyroidal Calcification

Three types of roentgenograms of the neck were obtained in 67 patients. In each patient, (1) the lateral view of the ordinary neck roentgenogram, (2) the lateral view of soft tissue roentgenogram and (3) the two spot, tangential views of soft tissue roentgenogram were retrospectively reviewed in this order.

The results is shown in Table 1. The ordinary roentgenograms presented psammomatous shadows in two instances, both of which were proved to be papillary carcinoma of the thyroid containing multiple psammoma bodies in the conglomerate form.

Coarse calcifications were observed in 18 instances. The lateral views obtained by a soft tissue

Table 1. Intrathyroidal calcifications identified on three types of roentgenograms of the neck

Type of roentgenogram	No. of patients examined	Calcifications on roentgenogram			
		None	Coarse alone	Psammomatous alone	Combined
Conventional, lateral view	67	47	18	2	0
Soft tissue, lateral view	67	41	24	2	0
Soft tissue, spot, tangential view	67	39	23	4	1

roentgenography presented calcific deposits much better defined than those on the ordinary neck roentgenograms, but the detectability of psammoma bodies remained the same and only coarse calcification was found in a higher incidence. The tangential views obtained by a specific technique applied in this study gave us far better result; combined psammomatous and coarse calcifications were observed in one, psammomatous alone in four and coarse alone in 23 instances.

Roentgenographic Findings in Patients with Thyroid Carcinoma

Twenty-three patients were operated upon and proved to have thyroid carcinoma. As shown in Table 2, preoperative roentgenograms of the neck disclosed combined psammomatous and coarse calcifications in four instances and psammomatous alone in five instances. Thus, in 9 patients, 39% of

Table 2. Intrathyroidal calcifications identified on the tangential view of the spot, soft tissue roentgenograms of the neck in 23 histologically proved thyroid carcinomas

Histological classification	No. of patients	Calcifications on roentgenogram			
		None	Coarse alone	Psammomatous alone	Combined
Papillary carcinoma	20	1	11	5	3
Follicular carcinoma	2	0	1	0	1
Anaplastic carcinoma	1	1	0	0	0
Total	23	2	12	5	4

all carcinomas, roentgenographic demonstration of psammomatous calcification gave us a strong support in making a preoperative diagnosis of carcinoma. Of these 9 patients, only one was easily diagnosed as carcinoma on the basis of physical findings. The clinical impressions of the other 8 patients were, as presented in Table 3, suggestive of carcinoma in 4, adenoma in one, chronic thyroiditis in 2 and lymph node metastases without a palpable thyroid tumor in one.

The patient No. 2 in Table 3, who was clinically suspected of carcinoma, had a oval mass of approximately 5 cm in diameter in the right lower neck. The surface of the tumor was rather smooth, but it was not readily movable to palpation. The soft tissue roentgenograms showed psammomatous calcification and a long linear calcific rim (Fig. 3), the finding being not typical for the usual thyroid carcinomas. When exposed at operation, the tumor was macroscopically well encapsulated and not fixed to the surrounding structures. Pathologic examination of the removed specimen revealed the follicular carcinoma with microscopically apparent capsular invasion. The linear calcific deposit was found at

Table 3. Summary of data in 23 patients with proved thyroid carcinoma

No.	Patient age, sex			Clinical impression	Calcification						Pathological diagnosis
					Roentgeno- gram of neck		Roentgeno- gram of specimen		Histologic section		
					Ps*	Co*	Ps*	Co*	Ps*	Co*	
1.	J.W.	35	F	Carcinoma	+	+	---	+	+	Papillary carcinoma	
2.	K.A.	56	F	Carcinoma?	+	+	+	+	+	Follicular carcinoma	
3.	S.O.	43	F	Carcinoma?	+	+	+	+	+	Papillary carcinoma	
4.	M.H.	52	F	Graves+ Carcinoma?	+	+	+	+	+	Graves' disease+ papillary carcinoma	
5.	S.S.	14	F	Chronic thyroiditis	+	—	+	—	+	—	Papillary carcinoma+ chronic thyroiditis
6.	T.T.	10	F	Chronic thyroiditis	+	—	+	—	+	—	Papillary carcinoma+ chronic thyroiditis
7.	K.K.	23	F	Adenoma	+	—	+	—	+	—	Papillary carcinoma
8.	S.T.	28	M	Adenoma?	+	—	+	—	+	—	Papillary carcinoma
9.	M.I.	45	F	Lymph node metastasis	+	—	+	—	+	—	Papillary carcinoma
10.	T.K.	37	F	Carcinoma	—	+	+	+	+	+	Papillary carcinoma
11.	K.O.	54	F	Carcinoma?+ hyperpara- thyroidism	—	+	+	+	+	+	Papillary carcinoma+ parathyroid adenoma
12.	K.K.	40	F	Carcinoma	—	+	—	+	+	+	Papillary carcinoma
13.	R.M.	42	F	Carcinoma?	—	+	—	+	+	+	Papillary carcinoma
14.	S.K.	40	F	Carcinoma	—	+	---	+	+	+	Papillary carcinoma
15.	S.S.	56	F	Carcinoma	—	+	—	+	—	+	Papillary carcinoma
16.	S.Y.	59	F	Carcinoma	—	+	—	+	—	+	Papillary carcinoma
17.	S.S.	32	F	Adenoma	—	+	---	—	+	+	Papillary carcinoma
18.	S.N.	44	M	Adenoma?	—	+	—	+	—	+	Follicular carcinoma
19.	T.K.	23	F	Chronic thyroiditis+ Carcinoma?	—	+	---	+	+	+	Papillary carcinoma+ chronic thyroiditis
20.	A.T.	61	F	Lymph node metastasis	—	+	—	+	—	+	Papillary carcinoma
21.	M.S.	61	M	Carcinoma	—	+	—	+	+	+	Papillary carcinoma
22.	T.T.	48	M	Carcinoma	—	—	—	—	—	—	Papillary carcinoma
23.	M.T.	64	F	Carcinoma	—	—	—	—	—	—	Anaplastic carcinoma

*Ps: Psammomatous calcification

*Co: Coarse calcification

the capsule, and psammomatous calcifications were due to the presence of both psammoma bodies and minute calcific deposits within the tumor stroma.

The patient No. 3 visited another hospital complaining of a tender, hard mass in the left thyroid lobe. At that time, subacute thyroiditis was suspected and prednisolone was administered. The thyroid mass became smaller and acute inflammatory signs gradually subsided. Three months later, one of us (Y.F.) examined the patient and found a hard, irregular tumor of 1.5 by 3 cm in size, slightly fixed to the trachea. Erythrocyte sedimentation rate was normal, a cold nodule was detected on the thyroid scintigram, and combined psammomatous and coarse calcifications were found on the soft tissue roent-

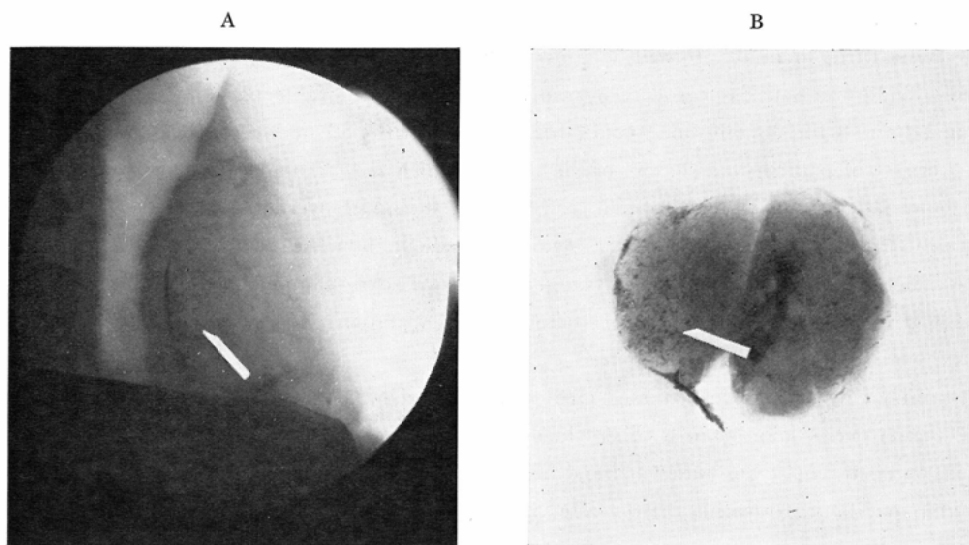


Fig. 3. (A) Soft tissue spot, roentgenogram of the neck, tangential view, in case No. 2, showing psammomatous calcifications (←) and a curvilinear calcium deposit. (B) Roentgenogram of the removed specimen.

genograms of the neck. Because of these positive findings for carcinoma, surgery was recommended. At operation the patient proved to have papillary carcinoma of the thyroid.

The patient No. 4 was referred to us for operation after having been treated at other hospital of her toxic diffuse goiter with antithyroid drugs. Soft tissue roentgenograms of the neck were obtained because of the presence of a hard, nodular mass in the left thyroid lobe in addition to the diffuse enlargement of the whole thyroid. The roentgenograms showed combined psammomatous and coarse calcifications. An association of carcinoma with Graves' disease was considered and it was proved at operation.

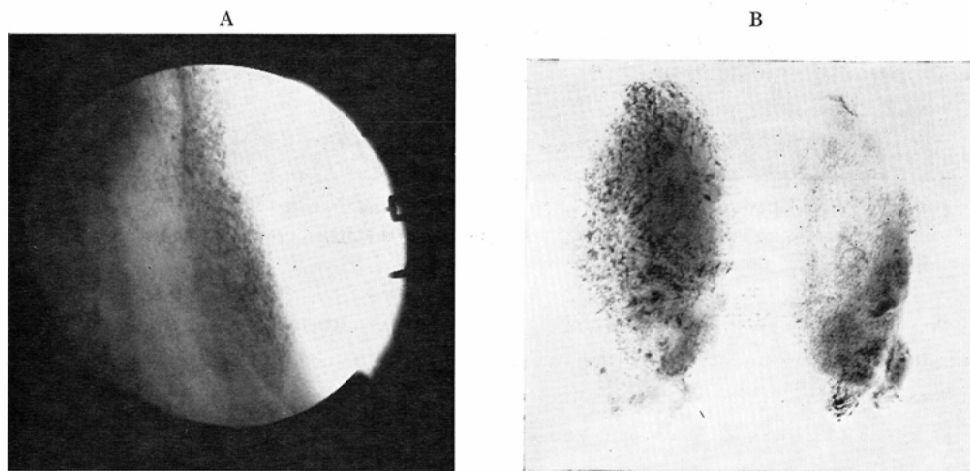


Fig. 4. (A) Preoperative roentgenogram of the neck in case No. 5, showing psammomatous calcifications throughout the whole thyroid lobes. (B) Roentgenogram of the surgical specimen: diffusely infiltrated, specific type of papillary carcinoma.

The patient No. 5 and 6 were both girls whose diffuse goiters were found by school doctors at the annual physical examination. Initially chronic thyroiditis was suspected on the basis of physical and laboratory findings. Soft tissue roentgenograms demonstrated multiple psammomatous calcifications distributed diffusely throughout the thyroid lobes (Fig. 4). Both patients were proved to have a diffusely infiltrative type of papillary carcinoma of the thyroid which was accompanied by chronic thyroiditis.

In both patients No. 7 and 8, round, readily movable nodules were present in the neck and were clinically suspected of benign adenomas. In both of them, however, ultrasound scanning revealed that the tumors were solid and soft tissue roentgenograms disclosed psammomatous calcifications. These findings had changed the diagnoses to carcinomas and operations were carried out. The histologic diagnoses were both papillary carcinomas.

The patient No. 9 had been treated medically for the lymph node enlargement in the left lateral cervical region over 6 months as a tuberculous lymphadenitis. As the clinical improvement was not obtained, an open biopsy was performed and histologically it was proved to be a metastatic lesion from the thyroid papillary carcinoma. Even after having obtained the pathological report, physical and

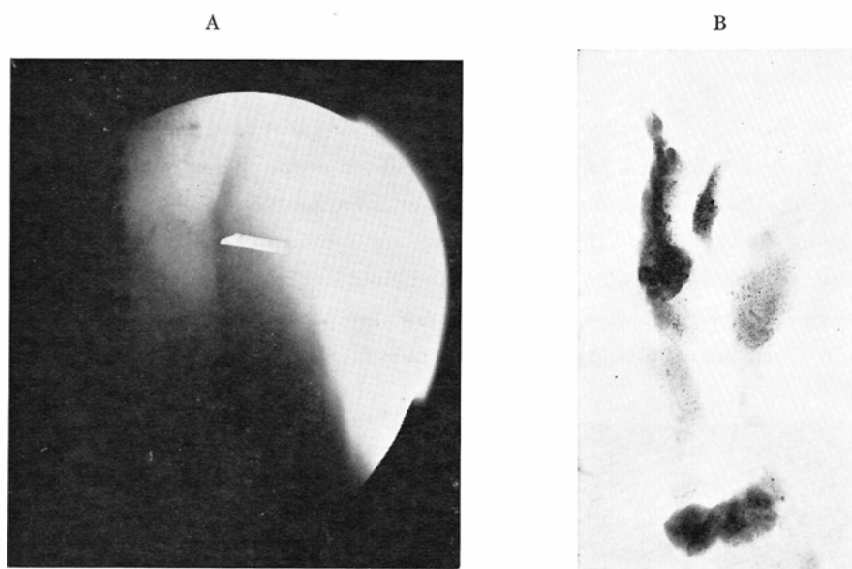


Fig. 5. (A) Preoperative roentgenogram of the neck in case No. 9. Definite, but minimal psammomatous calcifications were observed (←). (B) Roentgenogram of excised specimen, showing typical psammoma bodies.

laboratory examinations including very careful palpation and scintiscanning with radioiodine failed to demonstrate the primary tumor. Soft tissue roentgenograms of the neck presented definite, but minimal psammomatous shadows (Fig. 5). At surgery, the carcinoma of 1 cm in diameter was found in the ipsilateral lobe. On the specimen roentgenogram, multiple but individually separated, faint psammomatous calcifications were found within the tumor and also in the neighboring thyroid parenchyma.

Coarse calcification alone was recognized on the soft tissue roentgenograms of the neck in 12 patients with thyroid carcinoma. In 7 of them, preoperative physical examination of the neck revealed hard

or firm irregular mass, fixed to the trachea and thus the diagnoses of thyroid carcinoma were evident on the clinical basis.

In three other instances; patients No. 19, 20 and 21 in Table 3, the roentgenographic findings were helpful in making a diagnosis of carcinoma. The patient No. 19 had a diffuse goiter suggestive of chronic thyroiditis and in addition had a hard mass in the right lobe. The roentgenograms showed coarse calcification in the area corresponding to the mass, the finding being interpreted as indicative of the presence of some kind of neoplasm, because thyroiditis alone did not produce any calcific deposit. At operation, papillary carcinoma of 0.7 cm in diameter was found within the thyroid gland which was affected by chronic thyroiditis.

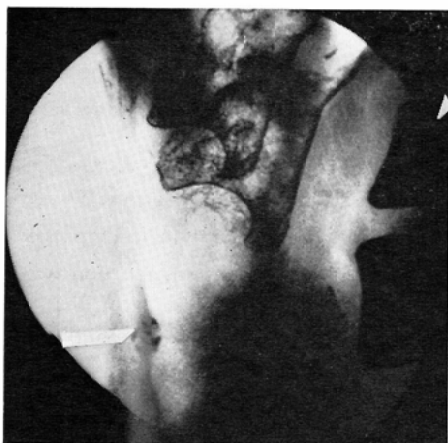


Fig. 6. Roentgenogram of the neck in case No. 20, showing the coarse calcifications; a small round calcium deposit. (←) At surgery, the calcified nodule was proved to be a primary carcinoma.

The patient No. 20 visited our hospital with a hard mass at the left submandibular area. It was removed and histologically diagnosed as a metastatic papillary carcinoma of the thyroid in lymph nodes. Soft tissue roentgenogram of the neck presented a coarse, round calcific deposit of approximately 3 mm in diameter (Fig. 6). With this roentgenographic finding in mind, a tiny nodule could be palpated at the left thyroid lobe. When exposed at surgery, two carcinoma foci each of 3 mm in diameter were found, one of which was corresponded to the calcified shadow on the film.

The patient No. 21 was referred to us by a laryngologist who detected paralysis of the left recurrent nerve of unknown cause. Routine roentgenograms of the neck demonstrated a irregular compression of the trachea on the affected side and soft tissue roentgenograms showed a small coarse calcification. A mass was hardly palpable, but an occult carcinoma of the thyroid was strongly suspected. The operation revealed that a papillary carcinoma of 8 mm in diameter had invaded to the trachea and the recurrent nerve.

During the period of this study there were only two patients with thyroid carcinoma whose roentgenograms of the neck did not show any calcific shadow in the thyroid area. The diagnoses of thyroid carcinoma in these cases, however, were evident on the physical findings of the tumors.

Soft tissue roentgenograms of the excised specimens were obtained in all the instances with thyroid carcinoma except for four. As shown in Table 3, in all the cases which presented psammomatous calcifications on the preoperative roentgenograms of the neck, psammomatous calcifications were more clearly detected on specimen roentgenograms and the presence of the bodies was confirmed on the histologic slides. Of 12 patients in whom coarse calcification alone was observed on the roentgenograms of the neck, two gave positive psammomatous shadows on the specimen roentgenograms and histologic examination revealed 5 more cases containing psammoma bodies. The bodies found only at the histologic examination were non-conglomerate, individually separated and were in numbers of less than 10 on one histologic section.

In addition to the above reported instances, four other patients were also studied, who were supposed to have carcinoma but not yet operated upon. One of them had a history of palliative operation for her papillary carcinoma 15 years before. Physical findings of the neck in these four patients were apparently indicative of thyroid carcinoma. Soft tissue roentgenograms of the neck showed coarse calcification in them all.

Findings in Patients with Non-malignant Thyroid Diseases

Roentgenograms of the neck in 47 patients with histologically proved non-malignant thyroid diseases disclosed coarse calcification in 28% (Table 4). The calcification was most common in adenomatous

Table 4. Intrathyroidal calcifications identified on the tangential views of the spot, soft tissue roentgenograms of the neck in 119 patients with proved or suspicious non-malignant thyroid diseases

Diagnosis		No. of patients	Calcifications on roentgenogram			
			None	Coarse alone	Psammomatous alone	Combined
Adenoma	Proved	24	17	7	0	0
	Non-operated	42	34	8	0	0
Adenomatous goiter	Proved	8	2	6	0	0
	Non-operated	21	11	10	0	0
Subacute thyroiditis	Biopsied	1	1	0	0	0
Chronic thyroiditis	Biopsied	13	13	0	0	0
	Non-biopsied	6	5	1	0	0
Graves' disease	Operated	1	1	0	0	0
	Non-operated	1	1	0	0	0
Recurrent nerve palsy	Non-operated	2	1	1	0	0
Total	Proved	47	34	13	0	0
	Non-proved	72	52	20	0	0

goiter. Psammomatous calcification was not found in any case. In Table 4, roentgenographic findings obtained in the other 72 patients not yet operated upon at the time of this writing were also presented. In those instances, the tentative diagnoses were based on physical and laboratory findings.

Discussion

It has long been recognized by pathologists that psammoma bodies are commonly seen in thyroid

carcinomas, whereas they are extremely rare in non-cancerous thyroid diseases (Klinck and Winship, 1959⁹⁾). Several roentgenologists have attempted to use the roentgenographic technique for the detection of intrathyroidal calcifications in the differential diagnosis between benign and malignant thyroid diseases, agreeing with the criteria that the presence of psammomatous calcification could be considered as diagnostic of carcinoma (Holtz and Powers, 1958⁸⁾); (Segal et al., 1960¹³⁾); (Gasquet et al., 1963⁴⁾); and (Margolin and Steinbach, 1968¹⁰⁾). The criteria were warranted in our present study, in which psammomatous calcification was found in 9 of 23 patients with proved thyroid carcinoma and found in none of 47 with proved non-malignant thyroid disorders. Thus it should be stressed that in this technique no false positive results are obtained.

The major problem to be solved has been how to demonstrate psammoma bodies of insufficient number and density on the roentgenograms of the neck. With the use of low kilovoltage and fine grain, industrial film, the dense, as well as the faint, deposits of calcium could be much better defined. The present study revealed, however, that lateral view of soft tissue roentgenography had contributed little to the detection of psammomatous calcification. Tangential views taken with the tube with its long, slender extension cone first gave us satisfactory result. Even by this technique, psammoma bodies in two instances which were clearly identified on the specimen roentgenograms failed to be demonstrated preoperatively on the neck roentgenograms. In general, the soft tissue roentgenographic technique now available needs prolonged exposure time and some motion is inevitable during the time. A little more technical progress would be expected by shortening of exposure time with the use of an intensifying screen of B.S. type Kyokko Dainihon, Tōryō (Co.) and the experiment is now being carried out by us.

As for reading of the roentgenograms, some basic knowledge on the diagnostic criteria is important. With an accumulation of experiences, the percentage of correct reading would increase. We had previously made repeated examinations on the soft tissue roentgenograms of excised specimens and had become familiar to the various patterns of thyroid calcification. The basic knowledge thus we had acquired was greatly useful in the reading of the neck roentgenograms.

With respect to the diagnostic importance of coarse calcification, we mentioned previously in the study on the specimen roentgenograms that most of coarse calcifications had no relationship to histologic diagnosis (Fujimoto and Akisada, 1970⁵⁾). After having experienced additional cases in the present study, the following statements seem to be more justifiable. (a) In general, the papillary and the follicular carcinomas of the thyroid containing coarse calcifications tend to present physical findings characteristic for malignant tumors, such as hard in consistency, irregular surface and fixation to the trachea. (b) Dense and irregular calcific deposits, compactly gathered to one area, are mostly due to the carcinoma. (c) A coarse calcific deposit less than 1 cm in diameter of any type of figure would indicate the presence of occult carcinoma of the thyroid, if it is observed in patients with diffuse goiter or those without any palpable thyroid mass. It is very likely especially when the patients present recurrent nerve palsy or metastatic lymph node enlargement without an apparent primary lesion. It is one of the great advantages of soft tissue roentgenograms of the neck that the small carcinomas not detectable by other methods are occasionally found by this technique.

Summary

In order to find out an optimal technique for a roentgenographic demonstration of intrathyroidal

calcification, an in-vitro investigation was carried out using a water phantom, in which three paraffin-block specimens of surgically removed thyroid carcinomas known to contain either psammoma bodies or coarse calcific deposits were placed. The results indicated that the best way now available was a tangential projection with the use of a technique of soft tissue roentgenography, the quality of roentgenograms being augmented by attaching an extension cone, 4.5 cm in diameter and 35 cm in length, to the tube.

The technique mentioned above, which was referred to as a soft-tissue-spot-tangential roentgenography, was applied to the patients with thyroid nodules. In 67 instances, an ordinary lateral view and a conventional soft tissue lateral view of the neck were also obtained. When compared these three types of roentgenograms, only the spot, tangential view was proved to contribute remarkably to the detection of psammomatous calcification of the thyroid nodules.

The conventional lateral view and the spot, tangential views of soft tissue roentgenogram of the neck were retrospectively reviewed in histologically proved 23 cancer patients and 47 non-malignant patients. Psammomatous calcification was detected in 9 instances, all of which were due to carcinomas. Of these 9 patients, only one presented physical findings apparently indicative of carcinoma and in the other 8, the roentgenographic demonstration of psammomatous calcification contributed greatly to the cancer diagnoses.

Coarse calcification alone on the roentgenogram of the neck was observed in 12 of 23 carcinomas and 13 of 47 benign nodules. In general, coarse calcifications of various figures bear no predictable relationship to malignancy, but in several instances the finding was helpful in making a diagnosis of carcinoma when considered along with physical findings. The conventional lateral view of soft tissue roentgenography was good enough to show coarse calcifications and has a benefit to present wider field than the spot tangential projection.

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