PUNCH BIOPSY OF SYNOVIAL MEMBRANE*

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An instrument has been devised which makes biopsy of the synovial membrane a relatively easy procedure. With this instrument the usual operative incision is unnecessary and the disability incident to operation is avoided. It has been used on 130 occasions to remove specimens from 135 joints of 108 patients, ranging in age from 3 to 71 years. Single procedures were performed on 93 patients, on the right knee 54 times, on the left knee 37 times, and on the elbow and shoulder once each. Multiple (two to six) procedures involving 42 joints were performed on fifteen patients; these entailed removal of specimens from the knees of ten patients on 32 occasions, and from both knees at one time of each of five patients (five occasions).† In the presence of sufficient distention by synovial effusion to permit safe introduction of the instrument it might also be used on the ankle or wrist joint. With added experience other applications have been found, including biopsy of bursae, diseased bone, and soft tissue masses (Bickel and Barber, 1951).

Techniques for aspiration or punch biopsy (usually for the purpose of making an early diagnosis of tumours) have been reported since about 1900, but the synovial membrane was apparently not considered among the many tissues easily accessible by such means (Franseen, 1941). A conspicuous if not isolated exception is a report by Forestier (1932), who commented on the potential value of synovial biopsy and described a modified barbed dental broach which could be inserted through the bore of a needle "to explore lymph nodes, synovia, etc.". Specimens were generally unsatisfactory however, and the procedure was abandoned (Forestier, 1951).

In July, 1948, while synovial fluid was being aspirated for inoculation into guinea-pigs because of suspected articular tuberculosis, enough synovial tissue was obtained in the tip of the needle to permit histologic diagnosis of tuberculosis. This experience led to more intensive efforts to devise an instrument whereby adequate specimens of synovial membrane could be consistently obtained. The principle of a punch technique has been utilized and in this respect the instrument resembles those used in transurethral prostatic resection. Results obtained to date justify the inclusion of synovial membrane among the tissues readily accessible to punch-biopsy procedure.

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† Hereafter in this paper all procedures, biopsies, or examinations performed at one time will be counted as one procedure, biopsy, examination, or instance. We shall refer to 130 procedures and 130 biopsies.

Description of the Instrument

The punch-biopsy set* consists of two main and two accessory parts (Fig. 1a to d'). There is first a hollow, round, stainless-steel tube 5 mm. ($\frac{3}{16}$ in.) in diameter, 12 cm. ($4\frac{3}{4}$ in.) in length, and 1.5 cm. ($\frac{9}{16}$ in.) in circumference (Fig. 1a). At one end is a flange handle marked to indicate the top (T); at the other end is a trocar point. Nine mm. ($\frac{3}{8}$ in.) from the trocar tip is an ovoid opening with a hooked lip in the end nearest the point. The aperture measures 7 mm. ($\frac{5}{8}$ in.) long and 2.5 mm. ($\frac{3}{32}$ in.) deep, and occupies the upper half of the diameter of the tube at this point. A hollow, tubular knife of the same material with a sharp, cutting rim closely fits the lumen of the outer tube (Fig. 1b). A stylet with a blunt end fits inside the inner tube (Fig. 1c). This stylet is used to push specimens out of the lumen of the tubular knife. Another stylet (Fig. 1d) is equipped with a sharp, hooked, corkscrew-like tip (Fig. 1d'), with which specimens of tissue can be extracted for examination without removal of the instrument from the joint.

FIG. 1a-d'.—Set for punch biopsy consisting of two main and two accessory parts.

Technique

Punch biopsy with this instrument is performed under sterile, aseptic conditions. Soap and water, alcohol, ether, and merthiolate are applied successively to the skin in the region of the joint to be examined. Four sterile towels are draped about the joint and clamped in place. Although in our experience this procedure was carried out in the operating theatre, with similar preparation and precautions the instrument may be used outside the theatre.

Anaesthesia.—Either a general or a local anaesthetic may be used. The age and temperament of the patient, the disease present or suspected, and the severity of articular pain and tenderness, are factors to be considered in the choice of anaesthesia. In certain diseases, such as acute gouty arthritis, pulmonary tuberculosis, and disseminated lupus erythematosus, local anaesthesia would be preferred. For 130 biopsies performed on different occasions included in this report, general and local anaesthesia were used 65 times each. With adequate local infiltration of an anaesthetic agent, pain is usually experienced only momentarily, if at all, when the synovial membrane is pierced by the instrument

* Manufactured by V. Mueller and Company, Rochester, Minn., U.S.A.

or when a specimen of tissue is being cut. In no instance in which local anaesthesia was used was it necessary to resort to general anaesthesia in order to complete the procedure.

Procedure.—When a punch biopsy of a knee is to be done, a small stab wound about 1 to 2 mm. long is made over the medial or lateral aspect of the suprapatellar pouch at the upper level of the patella. The inner tube of the instrument is fully inserted into the outer tube, thus covering the opening of the outer tube. The instrument is then introduced through the stab wound and directed toward the closest superior angle of the patella. It pierces the synovial membrane at this point and traverses the articular space beneath the quadriceps ligament. At the opposite side of the joint the tip of the outer tube can be

FIG. 2.—Diagram illustrating level of cross section shown in Fig. 3.

FIG. 3.—Cross section showing how synovial tissue is engaged in opening of outer tube.

palpated through the overlying skin and soft tissues. The inner cutting tube is then withdrawn sufficiently to open the aperture of the outer tube. That the instrument is in the joint space can be verified by the flow of synovial fluid out of the open end of the tube. Synovial fluid then can be collected for examination. With the inner tube withdrawn at least 1 cm., the hooked tip of the ovoid opening in the instrument is free to catch the synovial membrane. Moderate digital pressure, exerted externally on the top side of the outer tube where it is palpated in the suprapatellar pouch, facilitates the engaging of tissue in the opening (Figs 2 and 3). The inner, cutting tube is then fully re-inserted with a rotary movement to cut off the tissue engaged in the opening. The inner tube is again partially withdrawn, and the instrument is then ready to receive another specimen from the same area, or it can be moved to another place in the joint space and the same procedure repeated as many times as is desirable or necessary to obtain adequate specimens. The wound is sealed with a collodion cotton dressing, and an ace bandage is applied for 24 hours.

Specimens.—The various specimens removed collect within the lumen of the inner tube. An average of two to four is usually taken, and if desired, they can be withdrawn for examination with the corkscrew-like stylet. This is inserted and twisted clockwise several times to engage the tissue which has been cut off, and the stylet and specimen are then withdrawn. If the specimens are allowed to collect until the instrument is withdrawn, the blunt-tipped stylet is used to push out the tissue remaining within the inner tube.

Specimens of synovial membrane obtained in this way were usually 2 to 5 mm. wide and 3 to 7 mm. long. Occasionally specimens about 1 cm. long were obtained. It is desirable to obtain enough tissue to permit preparation of both frozen and fixed sections for histological examination and for tissue culture when indicated.

The technique is essentially the same for examination of other joints accessible by punch biopsy.

Post-Biopsy Morbidity

No post-operative reactions or disability have been encountered after the use of this instrument. Significant synovial bleeding was not noted in any case. In the course of these investigations this observation was confirmed by arthrotomy when feasible. No restrictions of the patient's physical activity were necessary on account of this examination. Ambulatory patients examined under local anaesthesia promptly resumed their previous activity, and physical therapy could be instituted or resumed within 24 hours.

By contrast an open operative procedure, even with antibiotics available, requires the facilities of an operating theatre, and the period of morbidity may continue for the 10 to 14 days which may be required to heal the incision. Because of this certain treatments may have to be delayed.

Punch biopsy of the synovial membrane without the operative incision and post-operative morbidity incident to arthrotomy has the advantages of minimizing discomfort, making hospitalization unnecessary, and appreciably reducing expenditure of time and money.

Analysis of Results

Sufficient synovial tissue was obtained for satisfactory histological and bacteriological examination from 112 of the 130 procedures (86.2 per cent.). In four instances (3.0 per cent.) the specimens were not considered satisfactory for histological diagnosis because of the absence of lining cells or because of insufficient tissue. No synovial membrane was obtained from fourteen (10.8 per cent.). Unsatisfactory results became fewer with increased experience, the addition of a hooked lip to the mouth of the aperture in the outer tube, and improvements in technique.

Comparison of Results of Punch Biopsy with Specimens obtained by Operative Procedures.—Eleven of the patients included in this series had an operative examination of the joint either before or after punch biopsy on the same joint. This permitted comparison of the specimens obtained by various methods. These results are shown in the Table. In all patients the specimen obtained by the punch procedure was as satisfactory for diagnosis as that obtained by the operative procedure (Figs 4, 5, and 6). In one case, although the tissue from both procedures

PUNCH BIOPSY OF SYNOVIAL MEMBRANE

281

TABLE
COMPARISON OF SPECIMENS OBTAINED BY PUNCH AND OPERATIVE
PROCEDURES ON SAME JOINT*

Case No.	Sex	Age (years)	Diagnosis	Procedure†		Interval (days)	Comment on Specimens
				First	Second		
1	M	51	rheumatoid arthritis	punch biopsy	synovectomy	0	Histologically comparable (Fig. 2). Punch biopsy would have been adequate.
2	M	49	rheumatoid arthritis	punch biopsy	arthrotomy	0	Histologically comparable. Punch biopsy would have been adequate.
3	M	61	rheumatoid arthritis	punch biopsy	necropsy	15	Histologically comparable. Punch biopsy under local anaesthesia. Death due to myasthenia gravis.
4	M	39	rheumatoid arthritis	punch biopsy	arthrodesis	76	Comparable synovitis, but neither specimen histologically diagnostic.
5	M	29	rheumatoid arthritis	arthrotomy	punch biopsy	83	Histological evidence on punch biopsy of improvement due to cortisone therapy.
6	M	37	rheumatoid arthritis	arthrotomy	punch biopsy	96	Histological evidence on punch biopsy of improvement due to ACTH therapy.
7†	M	67	tuberculosis	punch biopsy	arthrodesis	13	Histologically comparable.
8	M	18	tuberculosis	punch biopsy	arthrodesis	21	Histologically comparable (Fig. 3).
9	M	46	tuberculosis	arthrotomy	punch biopsy	55	Histologically comparable.
10	F	51	osteo-arthritis	punch biopsy	arthrotomy	11	Proliferation of superficial synovial cells and villous formation in both. Arthrotomy showed additional minimal cellular infiltration, but no focal collections of inflammatory cells.
11	M	15	osteo-chondromatosis	punch biopsy	synovectomy	4	Grossly and histologically comparable (Fig. 4).

* Both specimens were diagnostic in all except Case 4, in which neither specimen was diagnostic.

† The right knee was examined in all but Case 7, in which the left shoulder was examined.

was comparable, the specimens were each compatible with, rather than histologically characteristic of, rheumatoid arthritis.

Definite Clinical Diagnosis before Biopsy.—The procedure of punch biopsy of synovial membrane was performed 61 times on patients with previously established diagnoses (with the patients' consent) for purposes of investigation and for study of the effects of treatment on the disease. The clinical diagnosis was confirmed in 49 of the 61 examinations (80.3 per cent.).

The diagnosis of rheumatoid arthritis was supported by the microscopical examination of the synovial tissue (Allison and Ghormley, 1931; Collins, 1949; Dockerty, 1950) removed at 33 (84.6 per cent.) of 39 procedures; no synovial membrane was removed at 5 (12.8 per cent.), and the results of the examination of tissue removed at one procedure were considered indeterminate (2.6 per cent.).

A clinical diagnosis of tuberculosis had been made in ten instances. The results of punch biopsy of the synovial membrane confirmed this diagnosis in nine (90 per cent.), and were indeterminate in one (10 per cent.).

Acute gouty arthritis was the diagnosis in six instances. The synovial membrane obtained by punch biopsy was considered compatible with this diagnosis in three (50 per cent.) (Fig. 7), no synovial membrane was obtained from two (33.3 per cent.), and the results were indeterminate in one (16.7 per cent.).

FIG. 4.—Specimens of synovial membrane (haematoxylin and eosin; $\times 30$). They are histologically comparable and equally satisfactory for diagnosis.

A clinical diagnosis of traumatic or osteo-arthritis was confirmed in each of four instances. The results of punch biopsy in one case of dermatomyositis were indeterminate. In another case, in which a diagnosis of intermittent haemarthrosis had been made, no synovial membrane was obtained.

Indeterminate Clinical Diagnosis before Biopsy.—The diagnosis before biopsy was indeterminate in 69 instances, but with punch biopsy a definite diagnosis was established in 37 (53·6 per cent.). The diagnosis was still indeterminate after the biopsy in 32 (46·4 per cent.), including six in which no synovium was obtained.

(a) Obtained by punch procedure from the knee of a patient with articular tuberculosis, showing many typical tubercles, including some with giant cells ($\times 30$).

(b) Same specimen showing details of tubercle formation ($\times 200$).

(c) Obtained in course of arthrodesis 21 days after punch biopsy ($\times 30$).

FIG. 5.—Specimens of synovial membrane (haematoxylin and eosin). Tubercle formations similar to those noted in specimen obtained by punch procedure are seen.

FIG. 6.—Specimens of synovial membrane (haematoxylin and eosin).

Further analysis of this group reveals that rheumatoid arthritis was suspected clinically, but not established before biopsy, in 46 instances. The synovial specimen obtained in thirty instances (65.2 per cent.) was considered sufficiently characteristic to support the diagnosis of rheumatoid arthritis. Because of inconclusive results of biopsy the clinical diagnosis was not clarified by eleven procedures (23.9 per cent.). No synovial membrane was obtained from three (6.5 per cent.), and the synovial membrane obtained from two (4.4 per cent.) was considered compatible with a diagnosis of traumatic arthritis or osteo-arthritis.

After fifteen (65.2 per cent.) of the remaining 23 instances of synovial biopsy the diagnosis was still indeterminate, and no synovia was obtained from three

FIG. 7.—Specimens of synovial membrane obtained by punch procedure from the knee of a patient with tophaceous gout and acute gouty arthritis.

procedures (13.1 per cent.). In the five other instances (21.7 per cent.) the following diagnoses were made in one case each: synovial tuberculosis, rheumatoid arthritis, osteochondromatosis, osteo-arthritis, and normal synovial membrane. In the last instance marked obesity prevented satisfactory physical examination to determine whether any synovial inflammation was present. This and other experience indicates that normal as well as diseased synovial membrane can be removed with this instrument.

The opportunity of establishing a definite diagnosis in clinically indeterminate articular reactions is one advantage of the use of the punch biopsy.

Monarthritis.—Of the 108 patients on whom punch biopsy was performed, 26 had only a monarthritis. Diagnoses established with the aid of punch biopsy

of synovial membrane in these cases were: rheumatoid arthritis in thirteen (50 per cent.), synovial tuberculosis in three (11·6 per cent.), osteochondromatosis in one in which the roentgenograms revealed no abnormality (3·8 per cent.), and osteo-arthritis in one (3·8 per cent.). Biopsy was indeterminate in seven (27·0 per cent.), and no synovial membrane was obtained in one (3·8 per cent.). Thus, in eighteen of the 26 cases (69·2 per cent.), a diagnosis was established with the aid of punch biopsy.

Comment

Use of this relatively simple method of obtaining synovial tissue has permitted both the confirmation of clinical diagnoses and the recognition of articular disease not otherwise discernible by clinical and laboratory examinations. When the patient's history is difficult to evaluate, punch biopsy can be especially useful.

A satisfactory punch procedure produces a representative, accurate sample of either normal or diseased synovium, and can be carried out with very little inconvenience to the patient.

With easy access to synovial tissue, the various stages of different articular diseases can be studied more completely. The examination can be performed on a greater number of patients than was heretofore feasible and the same joint can be examined on repeated occasions. The same joint was examined by punch biopsy as often as six times in one patient in this series. This advantage is of considerable value in observing the response of synovial inflammation to various types of treatment (Hench and others, 1950).

When unsatisfactory, because of inadequate tissue or failure to obtain synovium, punch biopsy may have to be repeated or supplemented by an operative procedure. The ease with which a specimen may be obtained without the usual operative incision will generally offset the disadvantage of repeated biopsy or of an exploratory operation if either is indicated after punch biopsy. However, punch biopsy will not supplant arthrotomy in all instances. When a joint is explored after arthrotomy, an adequate specimen of synovium can be obtained, the articular cartilages can be examined, the absence, or extent, of panus formation can be determined, and the chance of missing a localized lesion, such as an haemangioma or tumour, is minimized. Furthermore, arthrotomy can be performed on any one of many joints, while punch biopsy is technically more adaptable to certain joints than to others. A knee joint was the site of every synovial punch biopsy reported herein except two.

Arthrotomy may still be the procedure of choice when the articular symptoms are suspected to be the result of mechanical alterations of function, and it may be necessary when punch biopsy cannot be used on the joint to be examined. On the other hand, when inflammatory or infectious articular disease is suspected in a joint suitable for the procedure, punch biopsy may be preferable.

Summary

(1) An instrument which will permit punch biopsy of synovial membrane without the usual operative incision is described. The instrument is introduced by inserting the trocar tip through a small stab wound.

(2) Punch biopsy has been performed with this instrument on 130 occasions on one or more joints of 108 patients. One or both knees were examined in 128 instances, and an elbow and a shoulder in one instance each.

(3) A sufficient specimen of synovium was obtained from 112 procedures (86.2 per cent.), and a definite diagnosis could be made in 86 instances (66.2 per cent.). Diagnoses established included rheumatoid arthritis, synovial tuberculosis, gouty arthritis, osteo-arthritis, osteochondromatosis, and normal synovium.

(4) The punch procedure described is a relatively simple method of obtaining an adequate, representative specimen of synovial tissue with little inconvenience to the patient.

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Prélèvement au Poinçon de la Membrane Synoviale

RÉSUMÉ

(1) On décrit un instrument qui permet de prélever la synoviale au poinçon évitant ainsi l'incision habituelle. La pointe du trocart placée au bout de cet instrument s'insère par une petite perforation.

(2) Le prélèvement au poinçon fut effectué 130 fois chez 108 malades sur une ou plusieurs articulations. Les deux genoux ou l'un d'eux furent examinés dans 128 cas et un coude ainsi qu'une épaule une fois chacun.

(3) Un échantillon de la synoviale de dimensions suffisantes fut obtenu après 112 prélèvements (86,2%) et un diagnostic exact put être établi dans 86 cas (66,2%). Entre autres on reconnut l'arthrite rhumatoïdale, la tuberculose synoviale, l'arthrite goutteuse, l'ostéoarthrite, l'ostéo-chondromatose et la synoviale normale.

(4) Le procédé de poinçonnage décrit ici représente un moyen relativement simple pour obtenir un échantillon suffisant et représentatif de tissu synovial sans incommoder trop le malade.

Biopsia al Punzón de la Membrana Sinovial

SUMARIO

(1) Se describe un instrumento que permite la biopsia al punzón de la membrana sinovial sin recurrirse a la usual incisión operativa. La punta del trocar del instrumento se introduce por una pequeña herida perforativa.

(2) Biopsia al punzón ha sido practicada con este instrumento en 130 ocasiones, en una o más articulaciones de 108 pacientes. Una o ambas rodillas fueron examinadas en 128 oportunidades y un codo, así como un hombro, una vez cada uno.

(3) Muestras suficientes de la membrana sinovial fueron obtenidas en 112 instancias (86.2 por ciento) y diagnóstico exacto se pudo establecer en 86 casos (66.2 por ciento). Entre los diagnósticos efectuados estaban incluidos los de artritis reumatoide, tuberculosis sinovial, artritis gotosa, osteoartritis, osteocondromatosis y tejido sinovial normal.

(4) El procedimiento de punzar descrito es un método relativamente simple para obtener una adecuada y representativa muestra del tejido sinovial sin incomodar mucho al paciente.