# EVALUATION OF SINUS-TRACK CULTURES IN CHRONIC BONE INFECTION

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**Sinus-track cultures were compared prospectively with cultures from operative specimens in 55 patients with chronic bone infection. There was a total of 115 operative isolates; 102 of the sinus-track isolates were identical (88.7%), showing a specificity of 95.7% and a predictive value of 90.3%.**

**A sinus-track specimen proved to be a reliable source for the isolation of all bacteria causing chronic bone infection except *Staphylococcus epidermidis*, provided that material from the depths of the sinus was aspirated by syringe from an active flowing sinus and inoculated immediately on culture media. Cotton-swab sinus specimens were unreliable for the isolation of mycobacteria, and could miss many pyogenic bacteria, or contain contaminants.**

**Tuberculous bone infection should be suspected if there is no growth of any pyogenic bacteria or if there is growth of *Staphyloccocus epidermidis* alone on routine aerobic and anaerobic sinus cultures. Mycobacteria can often be identified from sinus-track culture from patients in whom operative culture, histopathology and clinical examination have failed to confirm the diagnosis of tuberculosis.**

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The presence of a sinus is a clear indication of chronic osteomyelitis or infectious arthritis. The liquid discharge from the sinus should contain the bacteria which cause the infection to remain chronic. Some authors[1-3] support the use of sinus-track sampling to isolate the causative agents, but others consider it to be unreliable.[4-6] An alternative to taking a sample from a sinus track is to take it from bone in the depths of the infected site, but this usually requires surgery under anaesthesia. If the infection is due to tuberculosis or actinomycosis an operation may not be an essential part of treatment. When a large volume of material can be obtained from a sinus track, a good specimen is available for routine culture and centrifugation to allow mycobacterial culture and staining for acid-fast bacilli. At an operation on a bone, the amount of infected material may be scanty and give inconclusive results.

The aim of this study was to evaluate the reliability of sinus-track cultures in demonstrating the causative agents of chronic osteomyelitis.

## PATIENTS AND METHODS

Between September 1994 and August 1996 sinus-track cultures were compared prospectively with those of operative specimens from 55 patients with chronic bone infection. The collection of sinus-track specimens followed a careful procedure. The sinus orifice was cleaned with a cotton bud soaked in tincture of iodine. The superficial discharge in the sinus track was squeezed out gently and removed into a cotton ball soaked with iodine. Deeper material was then collected in a syringe by inserting its nozzle, without a needle, into the track and aspirating while simultaneously applying deep pressure. This was applied either by the author or, preferably, by the patient who had often learned how to produce a large amount of discharge from the sinus by voluntary muscle contraction, pressure or adopting certain postures. Only when the sinus was relatively dry was a specimen taken with a cotton-tipped swab, and for multiple sinuses the most active one was used. This procedure minimises the risk of sampling superficial contaminants and helps to obtain deep discharge containing the causative pathogens. The specimens for comparison were obtained directly from the infected bone or accumulated material in the soft tissues during operations which immediately followed the sinus-track sampling.

Both the sinus track and operative specimens were inoculated on to the culture medium immediately in the operating room; the use of transport media or delayed inoculation may allow the growth of possible contaminants or lead to the missing of anaerobes on culture. Aerobic and anaerobic routine cultures were made from all 55 patients, and mycobacterial cultures were made on Lowenstein-Jensen media from eight patients suspected of having tuberculous infection.[7,8]

For statistical purposes the following definitions[9] were used: *sensitivity* was the number of sinus isolates agreeing with operative cultures divided by the number of operative

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**Table I.** Correlation of sinus-track cultures with operative cultures

| Micro-organism | Total number of cases | Cases with positive operative culture | Sinus-track cultures: Total number of isolates | Number of operative isolates | Number agreeing with operative cultures | False-negative | False-positive | Sensitivity (%) | Specificity (%) | Predictive value (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| *Staphylococcus aureus* | 19 | 19 | 19 | 19 | 17 | 2 | 0 | *89.5* | *100.0* | *100.0* |
| *Staphylococcus epidermidis* | 5 | 1 | 5 | 1 | 1 | 0 | 4 | *100.0* | *92.6* | *20.0* |
| Streptococcus species | 7 | 7 | 7 | 7 | 6 | 1 | 0 | *85.7* | *100.0* | *100.0* |
| *Pseudomonas* species | 11 | 10 | 11 | 10 | 10 | 0 | 1 | *100.0* | *97.8* | *90.9* |
| Enterobacteriaceae | 24 | 24 | 35 | 31 | 26 | 5 | 4 | *83.9* | *88.6* | *86.7* |
| Anaerobic bacteria | 20 | 20* | 43 | 41* | 36 | 5 | 2 | *87.8* | *94.6* | *94.7* |
| *Mycobacterium tuberculosis* | 8 | 6† | 6 | 6† | 6 | 0 | 0 | *100.0* | *100.0* | *100.0* |
| Total | | | 126 | 115 | 102 | 13 | 11 | *88.7* | *95.7* | *90.3* |

* one patient with scapular actinomycotic infection was positive by sinus-track culture only because no surgical operation was done
† two patients only were positive by operative cultures while the other four were positive by sinus cultures and/or clinically and/or by histopathology. They were regarded positive to prevent misleading results because false-positive mycobacterial sinus cultures cannot occur

isolates; *specificity* was the number of patients with negative results by both operative and sinus cultures divided by the number of patients with negative results from operative cultures; and *predictive value* was the number of sinus isolates agreeing with operative cultures divided by the total number of sinus isolates.

## RESULTS

Of the 55 patients, 52 had positive results and three negative results on both sinus and operative cultures. The three double-negative cultures were from one patient with pyogenic osteomyelitis, which was probably negative because of parenteral antibiotic therapy, and two patients with tuberculous infections.

There were 115 isolates from the operative cultures (Table I) and 102 of the sinus-track isolates (88.7%) were identical with the operative isolates. Thirteen isolates were identified in the operative cultures but not in the sinus cultures (false-negative cultures). Eleven isolates were identified in the sinus cultures but not in the operative cultures (false-positive cultures). The *specificity* of sinus cultures was 95.7% and their *predictive value* was 90.3%.

The same organisms were grown from both the operative and the sinus culture in 24 (85.7%) of 28 patients with monomicrobial bone infection and 17 (70.8%) of 24 patients with bone infection and multiple isolates.

There was a high level of agreement between the sinus culture and the operative culture for all bacteria except *Staphylococcus epidermidis*. For this organism there was a low predictive value (20%) because of the high number of false-positive cultures (Table I). The sinus-track cultures, however, had a sensitivity of 100% and specificity of 92.6% for this organism.

Six isolates of *Mycobacterium tuberculosis* were obtained from the sinuses of eight patients with tuberculous infection while the operative cultures were positive in only two of the seven operative specimens. In one patient in whom the diagnosis of tuberculosis was confirmed by sinus culture no operation was performed. In three patients with positive sinus cultures the operative cultures showed no mycobacterial growth, probably because there was insufficient operative material. In one of these patients, in whom the provisional diagnosis had been an infected diabetic foot, the final diagnosis of tuberculosis was entirely based on the sinus culture; there was no clinical or histopathological suspicion. Pyogenic bacterial growth of *Staphylococcus epidermidis* was seen on routine aerobic and anaerobic cultures in none of the operative specimens and in only three of the sinus specimens from tuberculous patients. The finding of no growth on aerobic and anaerobic sinus cultures in three patients raised the suspicion of tuberculosis.

Deep and superficial sinus-track specimen cultures from the same patient were also compared with operative cultures (Table II). The deep specimen cultures had a higher sensitivity than the superficial cultures, but specificity and predictive value were similar.

Cultures from syringe-aspirated sinus specimens had a higher sensitivity, specificity and predictive value than cultures from cotton-swab specimens (Table III).

The cultures from dry sinuses had very low sensitivity (7.7%) and low predictive value (50%) compared with those from active flowing sinuses in the same patients (Table IV).

## DISCUSSION

This study confirms that sinus-track culture is a reliable method for the isolation of all bacteria causing chronic

**Table II.** Comparison between deep and superficial syringe-aspirated sinus-track cultures in the same patients related to operative cultures

| Number of patients | Total number of isolates | Cultures: Operative | Sinus-track: Deep | Sinus-track: Superficial |
|---|---|---|---|---|
| 11 | 21 | 21 | | |
| Number agreeing with operative cultures | | | 21 | 19 |
| False-negative | | | 0 | 2* |
| False-positive | | | 0 | 0 |
| Sensitivity (%) | | | *100.0* | *90.5* |
| Specificity (%) | | | *100.0* | *100.0* |
| Predictive value (%) | | | *100.0* | *100.0* |

* no anaerobic bacteria were isolated by superficial cultures

bone infection except for *Staphylococcus epidermidis*. This is because the latter is a predominant member of the normal skin flora which will contaminate sinus tracks.

The good agreement shown between the operative and the sinus cultures is attributed to the careful methods of collection and cultivation of the sinus specimens. Transport media were not used to convey the sinus samples to the laboratory because they can lead to overgrowth of contaminant bacteria, resulting in false-positive cultures. Superficial specimens and cotton-swab specimens in particular can miss anaerobes,[10] and were also found to be unreliable for the isolation of mycobacteria because they did not provide sufficient material for mycobacterial culture or for centrifugation.

The sinus cultures yielded the same pathogens as the operative cultures in 88.7% of isolates. Mackowiak et al[4] and Patzakis et al[3] have reported that sinus-track cultures were identical to operative cultures in only 44% and 57%, respectively. The reason for these lower findings may be attributed to sampling differences, particularly in regard to the study of Mackowiak et al[4] which was a retrospective study of 40 patients. Other authors have emphasised that sampling differences, specimen collection, culture techniques and the viability of the bacteria influence the results.[11,12] The varieties of organisms isolated also have an effect,[3] since the level of agreement between sinus and operative cultures was higher in patients with infection by a single organism (85.7%) than in those with polymicrobial infections (70.8%).

The findings of this study indicate that tuberculosis should be suspected if routine aerobic and anaerobic cultures from a flowing sinus do not support growth of any pyogenic bacteria, or if only *Staphylococcus epidermidis* is grown. In most patients with chronic osteomyelitis there is usually no urgency to commence treatment. Mycobacterial culture from sinuses can be repeated several times when aerobic and anaerobic routine cultures are negative, which will increase the chance of isolation of mycobacteria. The isolation of mycobacterial or an *Actinomyces* species from a sinus may determine the therapeutic strategy and prevent unnecessary surgical exploration. An important finding was that mycobacteria can sometimes be isolated from sinus-track culture when operative culture, histopathology and clinical examination have all failed to confirm the diagnosis. Patzakis et al[3] have also recommended that in chronic bone infection several cultures may be obtained from several sites to avoid missing the causative organisms.

**Conclusions.** It is better to obtain a sinus-track specimen by syringe aspiration rather than by a cotton swab from deeply located material rather than superficial, and from an active flowing sinus rather than a dry one. The specimen should be inoculated on culture media immediately, by the bedside, without using transport media. This will give a high probability of detecting the causative organism of chronic bone infection, before an operation is advised.

**Table III.** Comparison between syringe-aspirated and cotton-swab sinus-track cultures in the same patients related to operative cultures

| | | Cultures | | |
|---|---|---|---|---|
| | | | Sinus-track | |
| **Number of patients** | **Total number of isolates** | **Operative** | **Syringe** | **Swab** |
| 15 | 34 | 32 | | |
| Number agreeing with operative cultures | | | 32 | 19 |
| False-negative | | | 0 | 13* |
| False-positive | | | 0 | 2† |
| Sensitivity (%) | | | *100.0* | *59.4* |
| Specificity (%) | | | *100.0* | *98.4* |
| Predictive value (%) | | | *100.0* | *90.5* |

* two anaerobic organisms and one isolate of *Mycobacterium tuberculosis* were not isolated by cotton-swab cultures
† two false-positive isolates obtained by cotton-swab cultures were *Staphylococcus epidermidis*

**Table IV.** Comparison between active flowing and dry sinus-track cultures in the same patients related to operative cultures

| | | Cultures | | |
|---|---|---|---|---|
| | | | Sinus-track | |
| **Number of patients** | **Total number of isolates** | **Operative** | **Flowing** | **Dry** |
| 7 | 14 | 13 | | |
| Number agreeing with operative cultures | | | 13 | 1 |
| False-negative | | | 0 | 12 |
| False-positive | | | 1 | 1 |
| Sensitivity (%) | | | *100.0* | *7.7* |
| Specificity (%) | | | *93.3* | *93.3* |
| Predictive value (%) | | | *92.8* | *50.0* |

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