

PILOT SCOLIOSIS SCREENING PROGRAM
OF THE
NATIONAL RESEARCH COUNCIL

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A Case Study
for the
Science Council of Canada's
Study on Public Awareness
of Science and Technology

Final Report

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PILOT SCOLIOSIS SCREENING PROGRAM - National Research Council

Background

Scoliosis, a lateral curvature of the spine, has afflicted mankind since ancient times. Until recently, however, little progress has been made in treating it.

Scoliosis is relatively common, afflicting 10 percent of children in the 10 - 13 years age group. It actually starts at an earlier age but is very difficult to detect until the onset of the adolescent growth spurt. For most scoliosis sufferers, the curvature is so minor that it causes no problems, but one or two percent do have a serious curvature which, if untreated, worsens with age. Serious deformities can eventually cause a variety of back and internal problems, even premature death.

Scoliosis is grouped into three types based on origin. Structural scoliosis is either caused by congenital deformities of the spine itself, or can be a secondary result of muscular dystrophy -- or of muscle damage due to injury. Another form, functional scoliosis, results from some other deformity such as a short leg. But the most common form, ideopathic scoliosis - of unknown cause - accounts for 85 percent of all cases.

Until recently, there has been no major concerted effort to screen children for scoliosis. There are probably several reasons for this: successful therapeutic techniques are only now gaining widespread recognition; doctors were unaware of how widespread the disease was; and the usual technique for

scoliosis detection, the so-called bend test consisting of a naked eye examination of the child's back, is time consuming and not entirely sure. Nevertheless, screening programs have begun in earnest in the United States and are being conducted on a trial basis in Canada and Japan.

In Canada, a device developed by the National Research Council's Division of Physics promises to improve significantly the method of screening children for scoliosis. The device, referred to as a Moiré Contourgraph, was inspired by the Moiré technique, commonly used by NRC in engineering.

In the Moiré technique, contour lines of an object are produced as interference fringes while the object is illuminated by a spotlight through a special screen. The fringe pattern is produced by the interference of the screen and its shadow on the object. A photograph of the Moiré pattern on the human back permits an assessment of the overall body shape and the symmetry of the back.

The Moiré Contourgraph provides a simple, rapid analysis of spinal curvature. Preliminary tests were first conducted in 1976 and led to the development of a more sophisticated machine. In 1979, a survey conducted by an Ottawa team, including orthopedic surgeons Dr. Gordon Armstrong and Dr. Ian Adair, NRC scientist Dr. Marius Van Wijk and technical officer Mr. Manfred Paulun, indicated that the technique is far more accurate than the bend test and especially suited for mass screening programs.

The NRC device is simply a screen of uniformly spaced, black horizontal strings. When an ordinary incandescent light is shone on the child's back through the strings, an interference pattern known as Moiré fringes is formed, which appears like intermittent shadows on the back. The key to these shadows is that they delineate the contours of the back. If the child is normal, the contour patterns on both sides of the back are symmetrical; if the child has scoliosis, the patterns are asymmetrical, to the extent of the degree of curvature.

Although the device is simple to operate, it required considerable engineering skill and medical knowledge to develop it to its present stage of reliability. As well, a permanent record of the scoliosis sufferer's back is obtained by photographing the Moiré pattern. This is invaluable in determining the progression of the curvature and the effectiveness of therapy. At the same time, it limits the use of X-rays to the examination and verification of critical cases only. With all these advantages, the Moiré Contourgraph will help substantially in dealing with scoliosis.

Mass screening for scoliosis is still a little in the future. First it will be necessary to develop an automatic method for analyzing the Moiré photographs so as to eliminate the subjective element from the present process. It is hoped that perhaps within a year such an automatic reading method will have been developed. Afterwards, the Moiré technique could be used nationally for mass screening.

History of Program

As mentioned earlier, the National Research Council developed the scoliosis detection equipment. Dr. G. Armstrong, Chief of the Orthopedic Department of the Ottawa Civic Hospital, developed the scoliosis screening technique. Dr. Armstrong and Dr. Ian Adair, also of the Civic's Orthopedic Department, basically assumed the responsibility for implementing the scoliosis screening program, which required creating public awareness as well as raising the necessary funds.

The 1979 screening tests involved first an approach by Dr. Adair to Dr. L.H. Douglas, medical officer of health, Ottawa - Carleton Regional Health Unit. After an agreement was reached with the Ottawa - Carleton Health Board, a proposal went to the Ottawa Board of Education for approval. The Health Board did the spade work in obtaining approval from the Board of Education Trustees. Dr. Adair then went to the principals under the school board to explain the purpose of the pilot scoliosis screening program.

The Board of Education was very cooperative in having the children tested. It judged, however, that parental permission was needed to carry out any kind of tests. Hence, it prepared forms to this end which children had to bring home for the signature of their parents or guardians. No informative material accompanied the parental consent form. Information of a general technical nature on scoliosis screening was published in two issues of NRC's free information magazine, Science Dimension, in 1978 and 1979 but, as this publication is sent

only on request, it is unlikely that it had much impact on the children tested or their parents. It is more likely that awareness among parents was heightened most by the mass media (print and electronic) coverage of the program, described below. This coverage is owed largely to the initiative of Dr. Armstrong and the Ottawa Civic Hospital Administration. Children in some schools were shown a film on scoliosis screening prepared in Japan by a specialist from that country.

In any event, the response was overwhelmingly positive. The absentee rate for the Moiré Contourgraph test was only 9.5 percent; but taking into account the normal absentee rate in schools, the actual rate of refusal was probably no more than 3 or 4 percent. Follow-up tests were conducted at the Children's Hospital, but only in instances where an X-ray was required, and here the absentee rate was 15 percent.

Funding has consistently been a major problem. In 1977, after the preliminary scoliosis screening tests in 1976 involving a prototype Moiré machine, Dr. Armstrong, asked the Ottawa Civic Hospital Women's Auxiliary to purchase the more sophisticated machine. The Auxiliary raised the necessary \$6,000, from the operation of the hospital coffee shop, gift shop and beauty salon, as well as from the sale of magazines and from its remembrance fund. In 1978, the Auxiliary purchased the machine for the Orthopedic Department to be used by the hospital's scoliosis clinic and by the high schools in the Ottawa area. In addition, some sixty-five volunteers from the Auxiliary have helped with positioning and preparing the children for the screening tests.

In the 1979 screening tests, funding was again a problem. The Ottawa - Carleton Health Board eventually raised the necessary funds with the help of the Rotary Club of Ottawa which was approached by Dr. Armstrong at his own initiative. Dr. Armstrong spoke a number of times to its members to explain the request for funds. The Rotary Club, through its Crippled Children's Committee, donated about \$8,100 from its general funds for the purchase of the necessary film and computer time to assess the screening results. This was the first time the Rotary Club made a donation for the purposes of preventive rather than curative medicine.

On February 27, 1979, the Ottawa Civic Hospital held a press conference to explain the scoliosis screening program. At that time, a press release was issued detailing medical facts about scoliosis as well as acknowledging the donation of the Rotary Club. The press conference was well attended with reporters from both Ottawa's major English language newspapers, The Journal and The Citizen, as well as from the CBC, CTV, CHRO and certain radio stations. Dr. Armstrong was on hand to explain in detail the scoliosis screening program and to answer questions.

The press conference obtained prominent and extensive media coverage that was positive in tone, stressing the advantages of screening children for scoliosis as well as noting that some children may not benefit from the program due to their parents mistaken belief that X-rays would be used. The Citizen covered this story in a front-page article and

and had a follow-up story on its inside pages. It described in detail the benefits of the scoliosis screening program and the methodology used (Moiré technique). Dr. Armstrong thinks that the publicity, coming in the midst of the screening program, was helpful in winning public acceptance and support of the program.

As already mentioned, despite the benefits of adopting the Moiré Contourgraph method for a comprehensive screening program, there was some resistance. The public, governments, and, in some cases, even the doctors were largely unaware of the seriousness of the problem. Dr. Armstrong discovered 215 significant cases of scoliosis out of 6,000 children tested. The health of some of the children would have been permanently damaged had their affliction remained undetected. Yet, not all the parents cooperated in the screening program, owing largely to misinformation. Some feared the test, as they believed children would be exposed to radiation and not to harmless incandescent light. Others objected to their children being unclothed. They felt it was an invasion of privacy to have their children, at such a sensitive age, expose part of their buttocks. A letter complaining about children being forced to undress partially was written by a parent to a newspaper. However, undressing was necessary for proper alignment of the child behind the screen and the test requires even less exposure than the usual physical examination done in a doctor's office. Eventually, after a special positioning device is developed, it should be possible to screen children wearing their underpants.

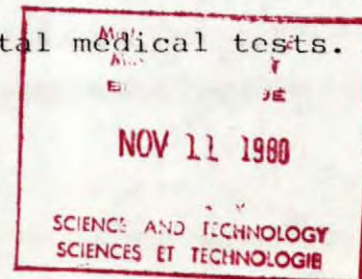
In addition to the articles published in Science Dimension, mentioned earlier, a special explanatory film is being prepared by the Division of Photogrammetry of the National Research Council. Its purpose is to help bring about acceptance by the general public of the Moiré method of diagnosis for scoliosis. The film will be geared to the children's level of understanding with the use of simple non-technical vocabulary. It also will show a row of children being photographed so as to overcome the children's feelings of shyness. As well, it will seek to allay the public's previously articulated fears by stressing that no radiation be used, only ordinary incandescent light. Notwithstanding these efforts, NRC has left the main responsibility for promoting public awareness of this method of detecting scoliosis to the medical authorities. The marketing of NRC-developed scoliosis screening equipment has been entrusted to Atomic Energy of Canada - Medical Products, which has used a mailing list obtained from the Association of Orthopedic Surgeons to inform potential users of availability.

Several other scoliosis screening programs have now been started in Toronto and Edmonton and another large scale test is planned in the Ottawa - Carleton region. It is hoped the results of these tests will spur more public awareness and eventually national screening of children for scoliosis.

Public Awareness

It appears that the public's perceptions of the scoliosis screening program is quite positive. Some 90.5 percent of all children under the jurisdiction of the Ottawa Board of Education received parental consent and were screened. The publicity given to the program by the newspapers and the Rotary Club as well as the enthusiastic endorsement by the Ottawa Board of Education were probably instrumental in winning the wide acceptance that it did.

The small rate of refusal seems to have been largely the result of misunderstanding (fear of radiation), a degree of concern with privacy (a dislike of having one's children submitted to tests), or certain psychological inhibitions (a dislike of having one's children partially undressed even for medical reasons). The reaction to some of these concerns by Dr. G. Armstrong, who was closely involved with the public in this program, is that, in dealing with any large number of people, it is inevitable that there would be some negative reaction. Continual emphasis on the fact that no radiation would be used is the only effective course of action to overcome the misunderstanding. The eventual development of a special positioning device should help overcome psychological inhibitions. Finally, the social acceptance that mass screening for scoliosis is harmless ought to eventually remove any feeling that children, instead of lab animals, are being submitted to possibly damaging experimental medical tests.



However, one needs to sound a note of caution on the readiness of the public to accept the scoliosis screening program. It should be stressed that the pilot test was carried out in Ottawa, a city with a much higher average per capita income level, a higher than average educational level and a well developed civic consciousness (the highest per capita charitable donations in the country). The reason that Ottawa was chosen for the screening test is because the lack of adequate funding required keeping down expenses, made possible in part by the close geographic proximity of NRC to the Ottawa Board of Education. Nonetheless, some U.S. states, such as New York and Delaware, make it compulsory to have some form of scoliosis screening. There has been no major public opposition to this. Consequently, there would be little reason to anticipate a very different public reaction in other parts of Canada in comparison with the reaction experienced in Ottawa.

