School Screening for Scoliosis

One Experience in California Using Clinical Examination and Moiré Photography

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In 1980 the legislature of the state of California mandated that school screening programs for scoliosis be implemented. This law resulted in variations in methods and efficacy of the programs. One such program using clinical examination and moiré photography was administered to adolescent girls in two secondary schools in Santa Clara County. The findings of 10% of the clinical examinations were ruled to be "positive," 18% on moiré photography alone and 8% on both examinations. The correlation between the two diagnostic procedures was poor (r = .16). Follow-up was done to determine the outcome of the "positive" cases. In all, 25% of the children classified as having scoliosis had no medical follow-up one year from the request by the screening program team. The documented false-positive rate was 15% based on the screening examination. Definitive radiographic evaluation was reported in very few of the positive cases.

Our experience shows the weakness of local programs that have no subject follow-up. It is suggested that public education may be a more effective solution than mass school screening mandates.

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Many countries today have school screening programs for spinal deformity. In 1980 California mandated via Assembly Bill 2168 a program of school spinal screening. Implementation and maintenance of the screening was on a local rather than a state level, leading to variation among the programs. We describe our experience with such a program of screening using clinical examination and moiré photography.

In 1973 Minnesota pioneered spinal screening in the United States by implementing a centrally directed, statewide but voluntary program based on clinical examination.[1] Most states now have programs, nine of which are state mandated. Japan is the only nation with a federally mandated screening program, mostly accomplished with surface topography using the moiré technique and low-dose roentgenographic techniques.[2]

Regardless of methods, reports of spinal screening efficacy have largely been encouraging,[3] though some have failed to achieve their goals.[4] Some authors have mentioned that a lack of subject compliance is a complication of mass screening programs.[5,6] This problem is addressed in this report.

Subjects and Methods

In all, 327 girls in grades five through eight of the Santa Clara County Public School System were screened for scoliosis. The screening consisted of a clinical postural examination and moiré photographs.[7] Results were determined to be "negative (normal)," equivocal or "positive (abnormal)" for scoliosis on the postural examination. The moiré photographs were judged by another observer (J.C.) at a later date as positive or negative based on fringe asymmetry.

On the clinical examination standing and bending symmetry was evaluated in the frontal and sagittal planes. A data form was used to record family, personal and medical histories and miscellaneous information in cases ruled positive. Criteria for positive rulings were any two of the following signs: decompensation of head and pelvis, shoulder asym-

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metry, spinous process deviation or a rib hump of at least 0.5 cm. Lesser rib humps and singular postural asymmetries were designated as equivocal signs.

The moiré photography system was a Fujinon FM40 fixed-focus camera mounted on an adjustable tripod. The girls stood in a special purpose positioner that was designed to stabilize standing position by tilting a person 10 degrees anteriorly. The camera was adjusted to the same plane. Positioning was simultaneously monitored by closed-circuit television to ensure correct alignment (Figures 1 and 2). We used 35-mm black and white film to produce prints for future comparison.

Letters were sent to the parents of 70 children in whom clinical examinations showed findings positive for scoliosis, asking that the children have further evaluation for scoliosis by their family physician or an orthopedist. A year later we attempted to determine the outcome of these efforts by sending a questionnaire to those parents.

Results

The incidence of positive and negative findings is summarized in Table 1. Six cases (1.8%) were classified as notable for postural problems other than scoliosis. Four children (1.2%) had pronounced kyphosis and were referred to their physicians. A total of 70 children who had equivocal or "positive" findings on screening for scoliosis or kyphosis were referred to their physicians.

TABLE 1.—*Results of a School Program of Screening for Scoliosis in 327 Adolescent Girls*

	Moiré Photography	
	Positive No. of cases (Percent)*	*Negative† No. of cases (Percent)*
Clinical Examination		
Positive*		
No. of cases (percent).	27 (8.3)	33 (10.1)
Negative†		
No. of cases (percent).	60 (18.3)	186 (56.9)

*"Positive" indicates abnormalities are present that suggest scoliosis.
†"Negative" indicates that results were normal.

The correlation between the screening examination and moiré photography was poor ($r=.16$). This was believed to be because of technical inconsistency in the moiré system, possibly due to moving it between two school sites. Because of this inconsistency, referrals were based on the postural examination only.

Of 70 cases in which referral letters were sent, we received 20 responses to the follow-up letter (28.6%). When known, the physicians who examined the children were contacted for their findings. Of these cases, six were previously classified

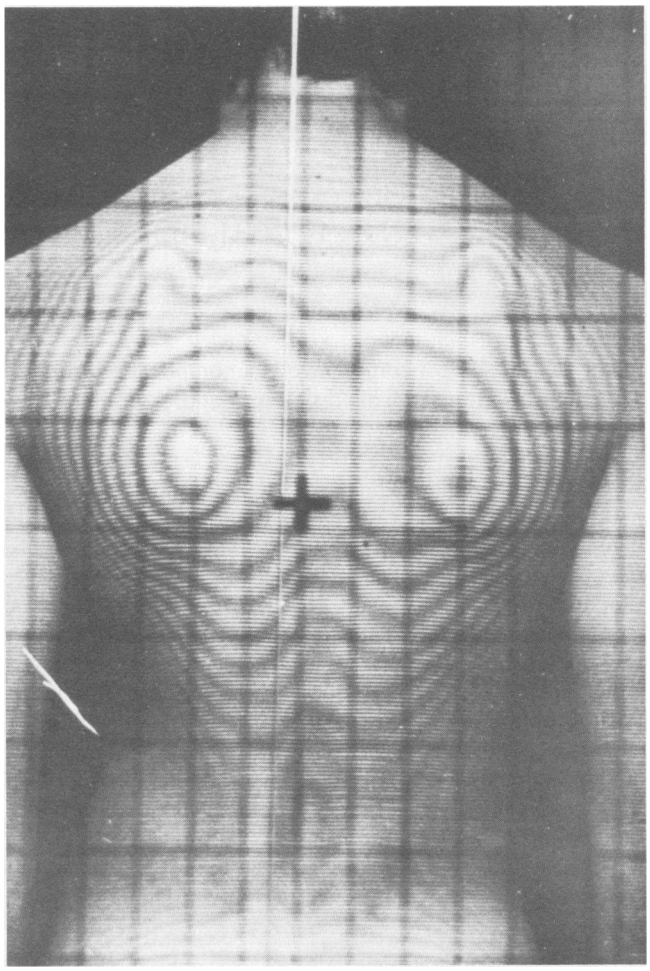

Figure 1.—A moiré photograph showing a normal spine.

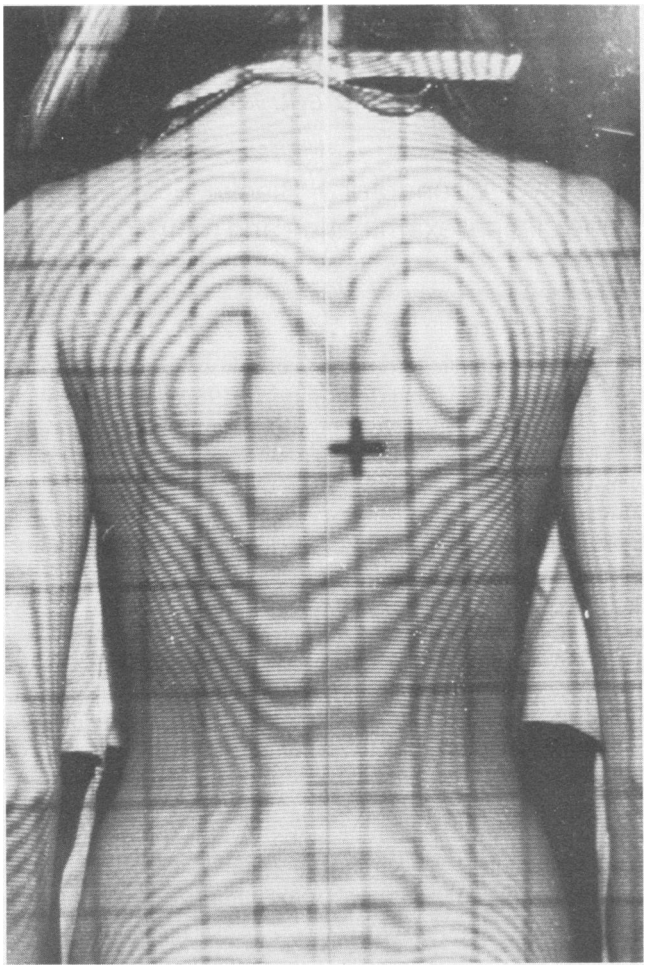

Figure 2.—A moiré photograph of a spine showing abnormal curvature.

as positive on both tests, 11 as positive on screening only and three were equivocal. Five of the responders indicated that a physician had not been consulted. Of the six responses in cases classified as doubly positive (on both clinical examination and moiré photograph), five were diagnosed as scoliosis; one of the patients had not seen a physician. Of the nine cases positive on examination only, two were diagnosed as not having scoliosis and five were diagnosed as having scoliosis; two of the patients had not yet seen a physician. Of the three cases with equivocal responses, two of the patients had not yet consulted a physician; in the other case a diagnosis of scoliosis was made.

Definitive degrees of curvature were reported in only two of the cases, a 31-degree curvature in a girl who had positive moiré and screening examinations and a 20-degree curvature in one with an equivocal examination. Five responses indicated "minor" or "small" curves.

Discussion

Of the 13 children who did have the follow-up examinations as recommended by us one year since the initial screening program, 11 had the diagnosis of scoliosis established; however, the degree of curvature was known in only two patients. The false-positive rate based on the limited responses we received was 15%. Although the correlation between moiré photography and clinical examination was poor, in all cases in which both were positive, scoliosis was confirmed by clinical or radiographic examination.

We could not ascertain the accuracy of scoliosis screening unless complete follow-up data were obtained. In this we were unsuccessful. Only 28.4% of our subject population reported that they had the recommended examination by their physician or available services at the county hospital. Our experience has shown that the mechanics of the screening program are easier to conduct than the most important objective, proper and complete diagnosis and treatment when indicated. Our study indicates inadequate communication between school nurses and parents, and possibly a lack of understanding by parents of the importance of a complete physical examination by a physician to confirm the diagnosis of scoliosis. Perhaps the significance of scoliosis in a growing child was not appreciated by the parents, and insufficient incentive for further follow-up was supplied. Complete follow-up by the school public health staff is compromised by insufficient state funds to back the state mandate. Furthermore, the enforcement of follow-up is ill defined in the law and no provisions for this are established. Should or can we "enforce" follow-up of a non-epidemic, non-life-threatening condition?

In our study we found that the gap between initial screening and follow-up was unacceptable and might have prevented early diagnosis and treatment of children who had a significant degree of scoliosis. Physical examination beyond screening is most important. Even though most cases of scoliosis are idiopathic, it is known that scoliosis can be the presenting sign of a spinal cord tumor and other neurologic and skeletal lesions.

The screening examination is simple and easy to learn. All parents or guardians could do this if they were taught. The promulgation of screening for scoliosis might be better accomplished as a public health measure through the use of spot commercials on television three to four times a year. This type of public health education might relieve the schools of just one additional imposed extracurricular activity and be more cost effective. In the Detroit public school system cost reductions, increased screening accuracy and improved follow-up were reported as a result of thorough parent, child and school staff education.[8] While scoliosis screening programs have been reported as highly successful in smaller, less mobile and more contained populations such as in Montreal,[9] Minnesota[1] and Sweden,[3] in a state as large as California with a highly mobile and varied population, it may not be practical. Finally, in a recent report on school screening,[4] of 31,956 children only 0.3% required treatment. The data of this study did not support the need for a legislated mass screening program based on the criteria of the World Health Organization to use an epidemiologic approach.

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