

Basal Cell Carcinoma of the Sole: Possible Association with the Shoe-Fitting Fluoroscope

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ABSTRACT

Basal cell carcinoma of the sole is very rare. This report describes an occurrence in which a basal cell carcinoma may have developed in relation to radiation exposure from a shoe-fitting fluoroscope. The obvious limitation is that there is no record or means to measure any amount of radiation that a person may have received from this primitive fluoroscope. We conclude that radiation very likely did induce this lesion in this individual.

INTRODUCTION

Non-melanoma skin cancer will be diagnosed annually in almost 1 million US citizens. Chronic sun exposure is the cause of most of these malignancies, but they also develop on non-exposed areas as well. Other known etiologies include contact with arsenic, exposure to radiation, and complications of burns, scars, vaccinations, and tattoos, as well as development in some congenital lesions, e.g., Nevus Sebaceous of Jadassohn.

This is a report of a basal cell carcinoma occurring on the sole of a foot with the carcinoma possibly developing as a secondary effect of radiation from a fluoroscope used as a shoe-fitting aid.

CASE REPORT

An 80-year-old white woman was evaluated in October 2004, regarding a persistent lesion involving her sole. The lesion was slightly painful and had enlarged over a period of 12-18 months. A biopsy of the 10mm lesion confirmed the presence of a basal cell carcinoma. The lesion was subsequently removed by Moh's surgery in 2 stages, leaving a final defect of 1.8 x 1.4 cm., which was closed with a full surface skin graft.

Histopathology

The skin biopsy revealed a neoplasm of nodular basalioid tumor with infiltrating architecture in the epidermal junction and the dermis. The tumor consisted of round to irregularly shaped nests of cells that demonstrated peripheral palisading. Within the tumor islands, cellular disorganization and dysmaturation were observed. Occasional mitotic figures and cellular apoptosis were identified. Stromal mucin was seen. Dermal solar elastosis was also evident. Immunohistochemical stains for CEA, BCL-2, and Cytokeratin 5/6 were performed on formalin-fixed, paraffin-embedded sections of tissue. The neoplastic cells were immunoreactive for BCL-2 and Cytokeratin 5/6. CEA expression was not observed.

DISCUSSION

For over 50 years, the patient and her husband owned a small, independent, and very successful children's shoe store in a small midwestern city. She worked with her husband in the shoe store throughout those years. Her work included clerking within the store, as well as helping customers with the selection and fitting of shoes. In the store, there was a fluoroscope that was used as a shoe-fitting aid for a period of at least 7 years. She could not specifically recall directly exposing her feet in the fluoroscope, but she did recall helping numerous children size and fit their shoes. Although the salespeople did not directly expose their skin to the radiation source, they were nearby while helping customers fit shoes. The patient must have used the machine numerous times, but does not recollect having done so.

Fluoroscopes were interesting devices that were promoted as aids in fitting shoes. In their impressive and thorough essay regarding the shoe-fitting fluoroscope, Duffin and Hayter¹ documented the development, distribution, and use of the fluoroscope in the United States, and the pedoscope in the United Kingdom. These machines became popular in the early 1920s, and

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Figure 1. Lesion on the patient's sole.

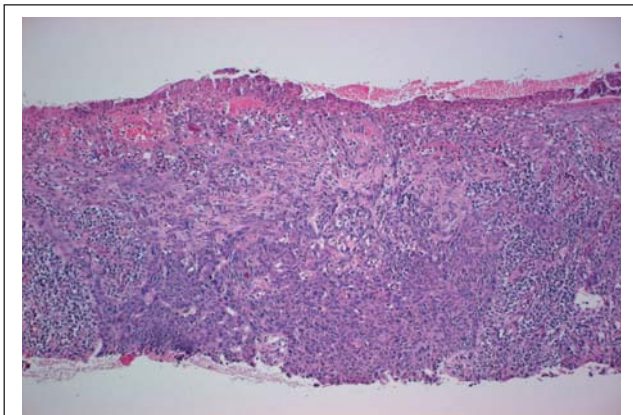


Figure 2. Hematoxylin and eosin.

proliferated until the 1950s. Their appeal to the public was to help insure a proper fit; therefore, they were used as a promotional means to help sell shoes. The leading manufacturer was the X-Ray Shoe Fitter Corporation of Milwaukee, Wis.

The primary component of the shoe-fitting x-ray unit was the fluoroscope, which consisted of a wood or metal cabinet containing an x-ray tube and its lead-shielded base, above which was a platform on which a customer placed his or her feet. When the x-ray tube was electrically activated with a switch operated by a sales clerk, a beam of x-rays passed upward and produced an image of the feet on a fluorescent screen. The screen was viewed through 2 or sometimes 3 eyepieces on top of the cabinet—1 for the sales clerk, 1 for the customer, and 1 for a third person who might have accompanied the customer. Later models featured enhanced lead lining and buttons that delivered different radiation intensities and times of exposure for men, women, and children. Constructed with attention to contemporary

or classic design, the fluoroscope cabinets were situated prominently in shoe stores.² At their peak in the early 1950s, 10,000 machines were said to be in the United States, 3000 in the United Kingdom, and an estimated 1000 in Canada.

Sold directly to shoe stores, often with very few instructions, these devices became very popular, especially with children. Customers might make multiple visits to several stores and therefore could have experienced repeated exposures within a short period of time. Machines tended to be poorly repaired and maintained, and sometimes were tampered with by shoe store personnel trying to acquire a better image. Clerks might place their hands in the radiation beam to adjust the position of a customer's foot, while customers could request a prolonged exposure period so they could adequately visualize their feet and shoes and, consequently, feel more confident of a proper fit. The lead shielding on later models made the machines so heavy that retailers would sometimes remove the extra shielding to reduce their weight.⁴

In 1948, a survey and evaluation of 200 fluoroscopes in the Detroit area found that 43 of these machines were potentially capable of exposing customers and shoe store employees to excessive radiation. Doses ranged from 16-75 roentgens per minute.⁵ In addition to the dose received by the feet, the entire bodies of a customer, a sales person, and a third person observer were bathed in radiation.

Few reports of damage by shoe-fitting fluoroscopes have been made to date. A report of chronic radiation dermatitis from a woman who had worked in a shoe retail business was reported in Copenhagen, Denmark, in 1957.⁶ She apparently had frequently demonstrated the safety of the machine by using it on herself.

In retrospect, it is astonishing that this marriage of early science and commerce occurred over several decades' time. The public's fascination with this magical visual display was not balanced by a consideration of its possible negative consequences. Certainly, regulation of these machines was absent throughout this period.

In April 1949, the American College of Radiology published an editorial in the *Journal of the American Medical Association* that indicated the potential hazards of the machines being used by people who had been inadequately trained in its use, and who were ignorant of its dangers.⁷ Two articles appeared in the *New England Journal of Medicine* in September 1949 that revealed the high and inconsistently measured radiation output of 12 operating machines, and that described potential medi-



Figure 3. Front and back views of a shoe-fitting fluoroscope. Wisconsin Historical Society, Image IDs: 10419 and 38213.

cal problems with foot development in children that was associated with radiation to the skin and bone marrow.⁸ In 1953, a review article appeared in *Pediatrics* that strongly advised against the use of the shoe-fitting fluoroscopes with children. A year later, the international commission for radiological protection recommended their use be restricted to “medical procedures.”⁹ It took until January 1957 before the first state banned the use of these machines. By 1970, these x-ray units were prohibited in 33 states.

There have been at least 27 previously reported basal cell carcinomas involving the sole of the foot.⁷⁻²⁵ Early descriptions of these tumors indicated the presence of histologic patterns characteristic of fibroepithelioma of Pinkus. A recent report suggests eccrine ducts serve as an initial template and, subsequently, are replaced by basal cell carcinoma cells.¹⁰ The authors do state, however, that eccrine duct spread of basal cell carcinoma may occur without necessarily imparting fibroepithelioma of Pinkus histologic pattern.

CONCLUSION

This report of a basal cell carcinoma involving the sole of the foot attests to the rarity of this occurrence. The

fact that this patient had worked in the direct vicinity of a fluoroscope for several years cannot be ignored. Whether this relationship is one of cause and effect is certainly open to speculation at this time. Certainly any future case reports of a similar nature would help to verify this as an etiological occurrence.

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