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## Technical Innovation and Note

# TRANSVAGINAL CONE ELECTRON BEAM TECHNIQUE FOR A VARIAN 18 MeV LINEAR ACCELERATOR

WILLIAM L. MCGINNIS, M.D., CHARLES J. BISCHOF, Ph.D and HOWARD B. LATOURETTE, M.D.

Department of Radiation Therapy, University of Iowa Hospitals and Clinics, Iowa City, IA 52242, U.S.A.

**Gynecologic neoplasms constitute a major portion of the radiation oncologist's work: carcinoma of the cervix occurs most frequently. The majority of patients can be treated in a standard manner but some can benefit by non-standard techniques such as a transvaginal cone. We describe a simple, economical device designed for use with a Varian Clinac 18 to administer transvaginal electron beam therapy. The technique is effective. It is adaptable to other sites, i.e. as an intra-oral technique for head and neck neoplasms.**

**Linear accelerator, Transvaginal electron therapy, Cervix carcinoma.**

## INTRODUCTION

The once popular use of transvaginal cone techniques for carcinoma of the cervix has decreased with the advent of megavoltage teletherapy and improved use of intracavitary brachytherapy. Transvaginal therapy with orthovoltage equipment has been used for a variety of situations in carcinoma of the cervix. Caulk reported on treatment of carcinoma of the cervical stump where an adequate radium application was difficult.[1] He again described transvaginal technique both alone and in combination with other techniques for all stages of carcinoma of the cervix.[2] Del Regato and Cox described 27 patients with carcinoma *in situ* who were treated with transvaginal therapy, and they reported excellent results.[5] Murphy has suggested that transvaginal therapy could be used for hemostasis of large, fungating lesions or for patients who are unable to receive intracavitary brachytherapy.[4] With present-day surgical and radiotherapeutic techniques, the use of transvaginal therapy has nearly become obsolete. We recently had a patient who could benefit from such a technique and have designed a system for its use with a Varian 18 MeV linear accelerator.

## METHODS AND MATERIALS

An adaptor for our linear accelerator was built to utilize an existing set of transvaginal cones. These cones previously had been used with an orthovoltage unit. Brass holders, approximately 23.5 cm in length, were designed to connect the transvaginal cones with the 8 × 8 cm electron cone provided with the linear accelerator. The brass holder also offered additional separation between the patient and the head of the linear accelerator. A brass coupling ring was designed to attach the holder to the electron cone. This coupling ring was used for all the transvaginal cones, while a separate holder was needed for each cone diameter. Figure 1 presents schematic diagrams of the coupling ring and the holder used in this particular patient. The transvaginal cone used has a 3.5 cm inner diameter (4.0 cm outer diameter).

The walls of the electron cone are made of plexiglas. A circular hole 5 cm in diameter was drilled in one of the plexiglas walls to facilitate the positioning of the patient. Figure 2 shows the transvaginal cone and the brass holder as well as the hole used to check patient positioning. The end of the transvaginal cone is cut at approximately a 30° angle. Therefore, the cross section has an elliptical shape and isodose curves are needed for planes parallel to the minor and major axes.

A film-pressed wood sandwich was irradiated when positioned parallel to both of these axes, and the films were analyzed using a Scanditronix densitometer system. Figure 3 shows the experimental arrangement used to expose the film parallel to the major axis. The oak boards and clamps compress the pressed wood

Reprint requests to: Charles J. Bischof, Department of Radiation Therapy, University of Iowa Hospitals and Clinics, Iowa City, IA 52242, U.S.A.

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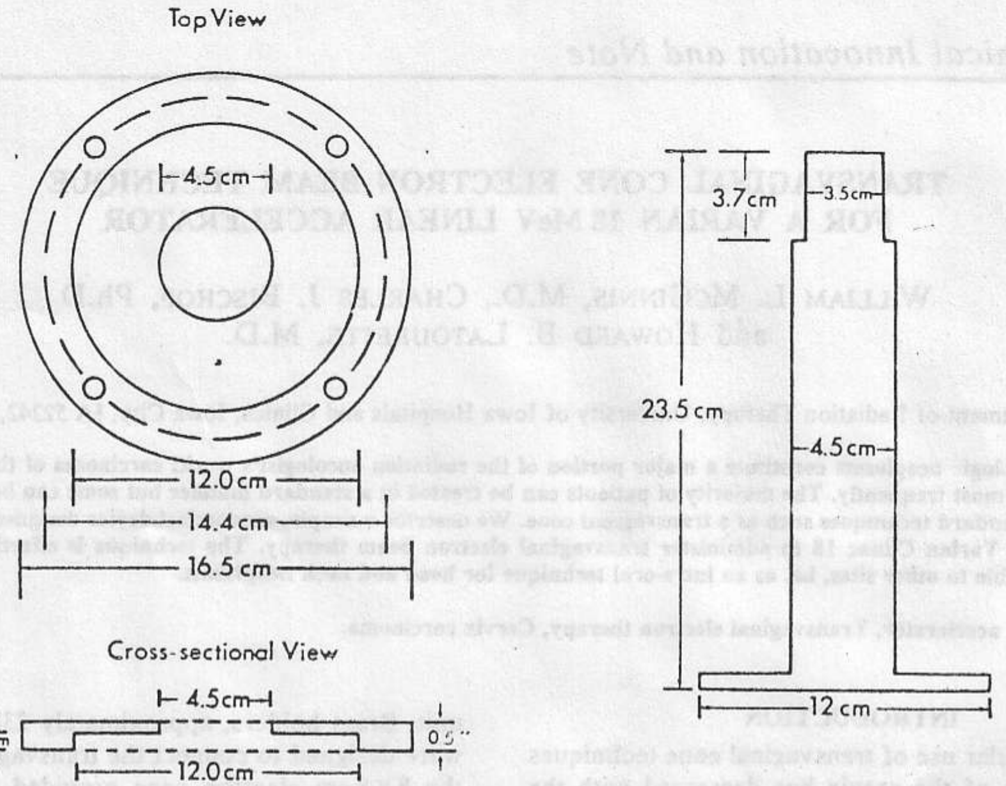


Fig. 1. Coupling ring and holder.

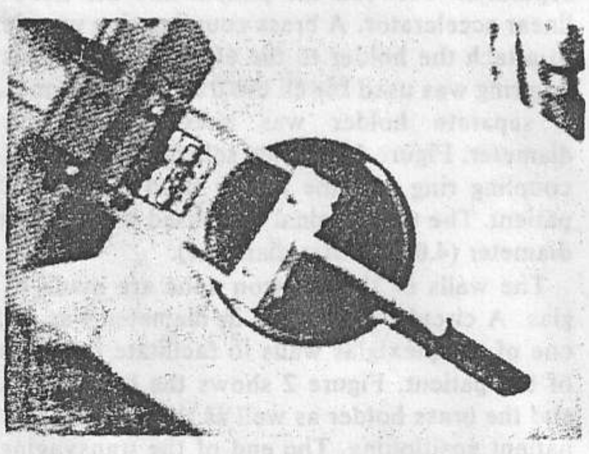

*Fig. 2. Treatment apparatus before insertion into patient.*

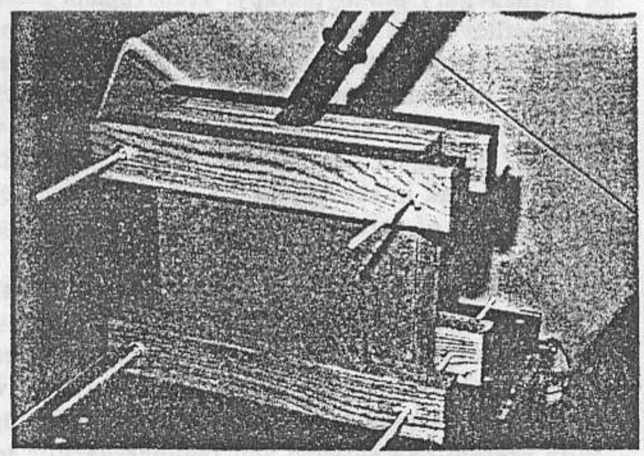

*Fig. 3. Experimental arrangement for film dosimetry.*

sandwich to remove air next to the film. For the film parallel to the minor axis the pressed wood sandwich was rotated 90° about the vertical axis. The resulting isodose plots for 12 MeV electrons and the trans-vaginal cone used appear in Fig. 4. The 85% isodose line is nearer the surface because of the oblique angle of incidence of the electron beam. Also, the isodose lines are fairly pointed since the width of the electron field is much less than the range of the electron in tissue.

A 33 year old woman had a 6 week history of postcoital bleeding, vaginal discharge, and abdominal cramping. The patient was referred to the University of Iowa Hospitals after biopsy revealed moderately differentiated squamous cell carcinoma. Initial examination revealed that the cervix was replaced by a $6 \times 8$ cm exophytic, ulcerated tumor which extended into the left vaginal fornix. No parametrial involvement was detected. The remainder of the work-up was negative, and the patient's disease was classified as Stage IIa according to the International Federation of Gynecologists and Obstetricians (FIGO) classification.[3] She was not a surgical candidate because of the bulk of the tumor. Therefore, we initiated radiation therapy using 10 MeV photons to deliver 180 rad/day through $17 \times 15$ cm anterior/posterior opposing fields. A total tumor dose of 4540 rad was delivered over five weeks. The lesion

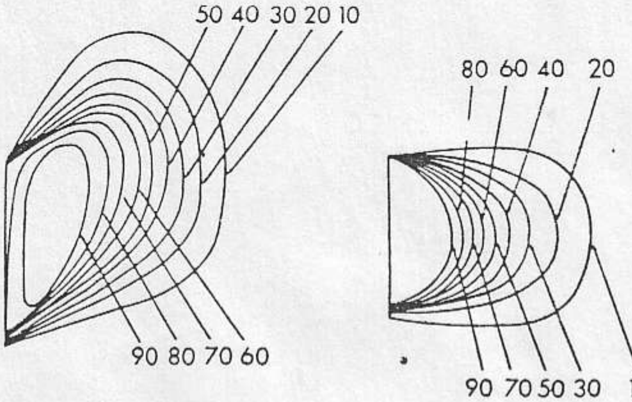


Fig. 4. Isodose plots for 12 MeV electron beam with transvaginal cone.

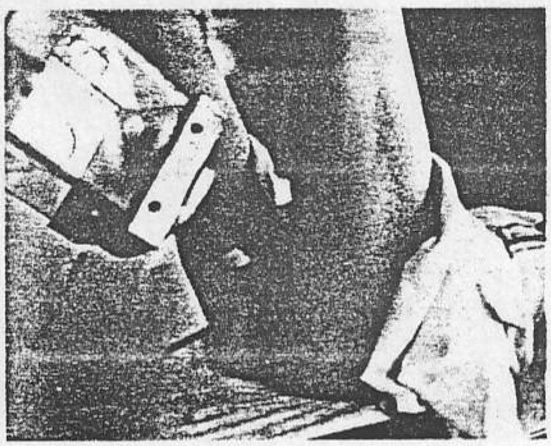

Fig. 5. Patient and apparatus in treatment position.

had regressed to $3.5 \times 3.5$ cm at the completion of external radiation therapy. The geometric configuration of the residual tumor would not allow satisfactory placement of the Fletcher system; therefore we elected to reduce the bulk of the tumor using transvaginal electron therapy.

The patient was placed on the treatment table in the lithotomy position. The 3.5 cm transvaginal cone was placed in the vagina and positioned in such a way that the cervix was visible within the cone. The patient was then asked to place her feet on the head of the machine, and the cone was attached to the holder by alternating vertical and longitudinal movement of the treatment table (Fig. 5). A lubricant jelly was used to facilitate the attachment of the cone to the holder. The position of the cone was confirmed using a laryngeal mirror, flash-light and the previously described hole in the electron cone.

The patient received 500 rad at the 85% isodose line on 25 July and 27 July 1977. The electron beam was directed at the bulky primary. The parametria were adequately irradiated using the usual pelvic fields and the photon beam.

## RESULTS

At the time of insertion of the Fletcher system radium applicator on 29 July 1977, the lesion had regressed to the point that the cervix was nearly normal in size. This regression allowed very satisfactory positioning of the Fletcher system. A second application was done one month later. The radium dosage planning was not modified to correct for the additional cervical dosage via our transvaginal cone. There were no immediate complications attributable to this technique.

## DISCUSSION

The use of transvaginal roentgen therapy has been an historic part of radiation oncology. Its use has dwindled along with the use of orthovoltage equipment and with the rise of better teletherapy and brachytherapy techniques. We feel that it continues to have certain applications in present-day radiation oncology. The technique described is simple, economical, and effective. It requires a cooperative patient with an introitus of adequate size to admit the cone. It also requires a lesion that will fit within the cone. The equipment and technique could easily be adapted to peroral use for head and neck neoplasms. The depth dose characteristics of electrons allow variations in technique to suit the individual patient which were not available with orthovoltage equipment.

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