

नेत्र कैंसर उपचारार्थ बीएआरसी Ru-106 प्लॉक
सात सफल वर्षों पर सार-संग्रह

Compendium on seven successful years of

BARC Ru-106 Plaque

for Treatment of Eye Cancer



Nuclear Recycle Group
Bhabha Atomic Research Centre
Trombay, Mumbai-400085, India

Setting Global Benchmarks in Ruthenium

BARC Ru-106 Plaques at Hospitals in India

Centre for Sight Hospital, Hyderabad

Dr. RPC Centre, AIIMS, Delhi

Sankara Eye Hospital, Bengaluru

Fortis Hospital, Gurgaon

Hinduja Hospital, Mumbai

Army Hospital, Delhi

Ramakrishna Eye Hospital, Coimbatore

Dr. LV Prasad Eye Hospitals, Hyderabad

Dr. LV Prasad Eye Hospitals, Vijayawada

Sri Shankara Cancer Hospital, Bengaluru

Malabar Cancer Centre, Thalassery

Dr. Shroffs Charity Eye Hospital, Delhi

Dhimahi Hospital, Ahmedabad

Max Hospital Saket, New Delhi

Smt. Jayaben Mody Cancer Center, Ankleshwar

MGM, Rajasthan

Plaque Ocular Brachytherapy

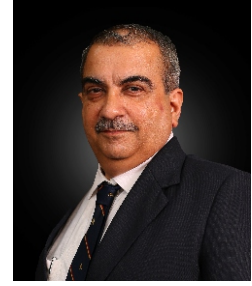
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संदेश

मुझे यह जानकर अत्यंत प्रसन्नता हो रही है कि दिनांक 8 अगस्त, 2026 को नेत्र कैंसर के उपचार हेतु रुथेनियम ब्रेकीथेरेपी पर राष्ट्रीय कार्यशाला के दौरान भाभा परमाणु अनुसंधान केंद्र द्वारा विकसित स्वदेशी Ru-106 प्लॉक का उपयोग करके नेत्रीय ब्रेकीथेरेपी की शुरूआत और इसे गति प्रदान करने में विगत सात वर्षों की उल्लेखनीय यात्रा का वर्णन करते हुए एक सार-संग्रह जारी किया जा रहा है। यह हमारे चिकित्सकों, चिकित्सा भौतिकविदों, वैज्ञानिकों एवं तकनीकी टीमों के सामूहिक समर्पण को प्रतिबिंबित करता है, जिनकी प्रतिबद्धता ने सटीक विकिरण उपचार के माध्यम से नेत्रीय दुर्दमताओं के रोगियों के सफल उपचार को समर्थ बनाया है।

प्रगत कैंसर देखभाल प्रौद्योगिकियों में भारत के आत्मनिर्भरता के लक्ष्य में, Ru-106 प्लॉक का विकास एवं नैदानिक कार्यान्वयन एक महत्वपूर्ण उपलब्धि है। वैज्ञानिक एवं प्रौद्योगिकीय उत्कृष्टता का प्रदर्शन करने के अलावा, इस उपलब्धि ने स्वास्थ्य पेशेवरों और शोधकर्ताओं के बीच बहु-विषयक सहयोग को बढ़ावा देते हुए नेत्र कैंसर के रोगियों के लिए प्रभावी, अंग-परिरक्षण उपचार तक पहुंच को आसान बनाया है।

मैं, इस कार्य में संलग्न सभी योगदानकर्ताओं को बधाई देता हूँ और इस बहुमूल्य संसाधन को एकत्रित करने में उनके समर्पित प्रयासों हेतु आयोजन समिति की सराहना करता हूँ। मैं, स्वदेशी Ru-106 को विकसित करने में भापअ केंद्र के अग्रणी योगदान को भी स्वीकार करता हूँ, जिसने इस सफल नैदानिक यात्रा को संभव बनाया है। मैं आशा करता हूँ कि यह संकलन नेत्र कैंसर के प्रबंधन में एक महत्वपूर्ण संदर्भ के रूप में कार्य करेगा।

यह राष्ट्रीय कार्यशाला नैदानिक अनुभव, तकनीकी विशेषज्ञता और नेत्र ब्रेकीथेरेपी में प्रगतिशील विकास को साझा करने हेतु एक उत्कृष्ट मंच प्रदान करती है। मुझे विश्वास है कि इस कार्यशाला के दौरान हुए विचार-विमर्श एवं ज्ञान का आदान-प्रदान रोगी के चिकित्सीय परिणामों में सुधार करने और इस विशेष विधि को अपनाने के हमारे सामूहिक प्रयासों को और अधिक बल प्रदान करेगा।

मैं, इस राष्ट्रीय कार्यशाला की सफलता के लिए शुभकामनाएं देते हुए कैंसर के उपचार हेतु स्वदेशी प्रौद्योगिकियों को आगे बढ़ाने में और भी अधिक उपलब्धियां हासिल करने की आशा करता हूँ।

29.07.2026

विवेक भसीन
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Member, Atomic Energy Commission



MESSAGE

I am pleased to note that a compendium describing the remarkable journey of the past seven years in establishing and advancing ocular brachytherapy using the indigenous Ru-106 plaque developed by the Bhabha Atomic Research Centre is being released during the National Workshop on Ruthenium Brachytherapy for the Treatment of Eye Cancer on August 8, 2026. It reflects the collective dedication of our clinicians, medical physicists, scientists, and technical teams, whose commitment has enabled the successful treatment of patients with ocular malignancies through precision radiation therapy.

The development and clinical implementation of the Ru-106 plaque represents a significant milestone in India's pursuit of self-reliance in advanced cancer care technologies. Beyond demonstrating scientific and technological excellence, this achievement has enhanced access to effective, organ-preserving treatment for patients with eye cancer while fostering multidisciplinary collaboration among healthcare professionals and researchers.

I congratulate all the contributors and commend the organizing committee for their dedicated efforts in bringing together this valuable resource. I also acknowledge the pioneering contributions of BARC in developing the indigenous Ru-106 plaque, which has made this successful clinical journey possible. I hope this compilation serves as a valuable reference in the management of eye cancer.

The National Workshop provides an excellent platform for sharing clinical experience, technical expertise, and emerging developments in ocular brachytherapy. I am confident that the deliberations and knowledge exchange during this workshop will further strengthen our collective efforts to improve patient outcomes and expand the adoption of this specialized treatment modality.

I extend my best wishes for the success of the National Workshop and look forward to many more milestones in advancing indigenous technologies for cancer care.

(Vivek Bhasin)

29.07.2026



नेत्र दृष्टि का आश्वासन

बीएआरसी Ru-106 नेत्र प्लॉक



भारत में, नेत्र कैंसर के इलाज के लिए स्वदेशी रूप से विकसित रूथेनियम (Ru)-106 प्लॉक का उपयोग करके ब्रैकीथेरेपी के सफल सात वर्षों के उपलक्ष्य में, नाभिकीय पुनःचक्रण वर्ग, भाभा परमाणु अनुसंधान केंद्र (बीएआरसी) को इस संग्रह, जिसमें बीएआरसी Ru-106 नेत्र प्लॉक के विकास से नैदानिक अनुप्रयोग तक की यात्रा का दस्तावेजीकरण किया गया है, को प्रस्तुत करते हुए अपार हर्ष की अनुभूति हो रही है।

Ru-106 नेत्र प्लॉक का विकास नाभिकीय विज्ञान, रेडियो रसायन, पदार्थ अभियांत्रिकी, चिकित्सा भौतिकी और नैदानिक कर्करोग विज्ञान के एक अद्वितीय समाभिरूपता का प्रतिनिधित्व करता है। नाभिकीय ईंधन चक्र और रेडियोआइसोटोप उत्पादन में दशकों की विशेषज्ञता का लाभ उठाते हुए, भापअ केंद्र ने उच्च गुणवत्ता वाले Ru-106 नेत्र प्लॉक के विनिर्माण के लिए एक स्वदेशी तकनीक सफलतापूर्वक विकसित की, जिससे भारत एक महत्वपूर्ण चिकित्सा उपकरण में आत्मनिर्भरता प्राप्त करने में सक्षम हुआ जो पहले आयात पर निर्भर था।

नैदानिक व्यवसाय में बीएआरसी Ru-106 प्लॉक को शामिल किए जाने के बाद से, इसे देश भर के प्रमुख नेत्र केंद्रों में अपनाए जाने में लगातार विस्तार हुआ है। यूविल मेलानोमा, रेटिनोब्लास्टोमा, चाक्षुष सतह शल्की निओप्लासिया परिगत कोरॉयडल हेमांगियोमा एवं अन्य चयनित चाक्षुष ट्यूमर वाले सैकड़ों रोगियों को इस दृष्टि-संरक्षण उपचार से लाभ हुआ है। उत्साहजनक नैदानिक परिणामों ने प्लॉक की संरक्षा, विश्वसनीयता और चिकित्सीय प्रभावशीलता की पुष्टि की है।

यह संकलन वैज्ञानिकों, इंजीनियरों, चिकित्सा भौतिकविदों और नेत्र कर्क रोग विशेषज्ञों के सहयोगात्मक प्रयासों के माध्यम से प्राप्त वैज्ञानिक, तकनीकी और नैदानिक उपलब्धियों पर प्रकाश डालता है। इसमें रेडियोन्यूक्लाइड उत्पादन, प्लॉक निर्माण, गुणवत्ता आश्वासन, डोजीमेट्री, नैदानिक अनुप्रयोग और उपयोगकर्ता अनुभवों सहित उत्पादन की संपूर्ण गाथा शामिल है।

हम आशा करते हैं कि यह सार-संग्रह एक उपयोगी संदर्भ के रूप में कार्य करेगा। यह स्वदेशी प्रौद्योगिकियों को विकसित करने में भारत की बढ़ती क्षमता का प्रमाण है जो दृष्टि को संरक्षित करती है, जीवन काल में सुधार और नेत्र ब्रैकीथेरेपी में भारत की आत्मनिर्भरता की दिशा में एक महत्वपूर्ण कदम है।

डॉ. सुजीलाल

(डॉ. जी. सुजीलाल)

विशिष्ट वैज्ञानिक एवं

निदेशक, नाभिकीय पुनःचक्रण वर्ग

भाभा परमाणु अनुसंधान केंद्र



Assurance of Vision

BARC Ru-106 Eye Plaque



To commemorate seven successful years of brachytherapy using indigenously developed Ru-106 plaque for treatment of eye cancers in India, Nuclear Recycle Group, Bhabha Atomic Research Centre (BARC), is pleased to present this compendium, documenting the journey of the BARC Ru-106 eye plaque from development to clinical application.

The development of Ru-106 eye plaques represents a unique convergence of nuclear science, radiochemistry, materials engineering, medical physics, and clinical oncology. Leveraging decades of expertise in nuclear fuel cycle and radioisotope production, BARC successfully developed an indigenous technology for manufacturing high-quality Ru-106 ophthalmic plaques, enabling India to achieve self-reliance in a critical medical device that was previously dependent on imports.

Since the introduction of BARC Ru-106 plaques into clinical practice, their adoption has steadily expanded across leading ophthalmic centres in the country. Hundreds of patients with uveal melanoma, retinoblastoma, ocular surface squamous neoplasia, circumscribed choroidal hemangioma, and other selected ocular tumors have benefited from this vision-preserving treatment. The encouraging clinical outcomes have reaffirmed the safety, reliability, and therapeutic effectiveness of these indigenously developed plaques.

This compilation highlights the scientific, technological, and clinical milestones achieved through the collaborative efforts of scientists, engineers, medical physicists, and ophthalmic oncologists. It covers the complete product story, including radionuclide production, plaque fabrication, quality assurance, dosimetry, clinical applications, and user experiences.

We hope this compendium serves as a useful reference and stands as a testament to India's growing capability to develop indigenous technologies that preserve vision, improve lives and marks a significant step towards India's self-reliance in ocular brachytherapy.



(Dr. G. Sugilal)
Distinguished Scientist &
Director, Nuclear Recycle Group
Bhabha Atomic Research Centre





*Where Knowledge Inspires Innovation,
and Precision Preserves Vision*

Eye Cancer - An Overview



Eye Cancers, though infrequent, pose significant risks to both vision and patient due to their potential to affect multiple ocular structures. The pathogenesis of most eye cancers remains incompletely elucidated. However, established risk factors include genetic alterations, hereditary predispositions and a prior oncologic history. Timely identification and intervention are paramount to preserving visual function, achieving local tumor control and preventing metastatic dissemination. Advances in the field of eye cancers have led to the emergence of eye-saving therapeutic modalities, which allow for effective tumor management while maintaining the anatomical integrity of the eye and functional vision.

Types of eye cancers

Eye Cancers are categorized into primary tumors, which originate within the eye, and secondary tumors, representing metastatic spread from distant sites.

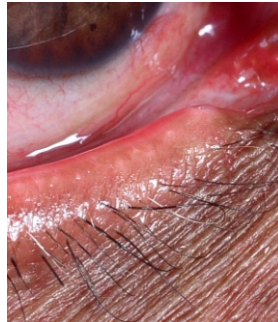
Primary ocular cancers encompass uveal melanoma, retinoblastoma, conjunctival

melanoma, ocular lymphoma and conjunctival squamous cell carcinoma. Among these, uveal (choroidal) melanoma is the predominant primary intraocular malignancy in adults, whereas retinoblastoma is the most frequently diagnosed eye cancer in children. Epidemiological data describing the incidence and distribution of these malignancies are summarized in Table 1.

Treatment modalities

Treatment selection for ocular tumors is guided by tumor characteristics (including type, size, location and stage), patient's overall health status and potential for visual preservation. Major treatment options are:

- Laser Therapy
- Radiation Therapy including Plaque brachytherapy (Ru-106, I-125)
- Proton beam therapy
- External beam radiotherapy
- Surgery local tumor resection
- Enucleation for large or advanced tumors
- Immunotherapy, etc.



Role of Ru-106 Plaque Brachytherapy

Ruthenium-106 plaque brachytherapy represents a vital globe-sparing modality for the management of select intraocular tumors, most notably uveal melanoma. This technique administers a concentrated dose of beta radiation directly to the tumor site, ensuring maximal tumoricidal effect while significantly limiting radiation exposure to adjacent healthy ocular structures.

Clinical Applications

- Serves as a primary treatment option for small to medium-sized uveal melanomas.
- Effective in selected cases of choroidal melanoma.
- Utilized as a salvage therapy in retinoblastoma management.

Advantages

- Preservation of the globe and visual function, particularly when lesions are located away from critical structures such as the macula and optic nerve.
- Highly localized radiation delivery due to the limited penetration depth of beta particles, minimizing collateral tissue damage.
- Single-course continuous radiation treatment over several days, reducing the need for repeated hospital visits and enhancing patient convenience.

This targeted therapeutic approach balances oncologic control with functional preservation, making Ru-106 plaque brachytherapy a preferred option in ocular oncology for appropriate tumor profiles.

Table 1: Statistics of Eye Cancer cases.

Cancer type	Worldwide	India
Retinoblastoma	8,000–9,000 new cases/year	1,500–1,800 new cases/year
Uveal melanoma	4–8 cases per million population/year	<1 case per million population/year
Ocular Surface Squamous Neoplasia (OSSN)	More common in tropical countries with high UV exposure	Relatively more common than uveal melanoma

- Eye Cancers are rare. However, they are potentially sight and life-threatening conditions that require early and accurate diagnosis to optimize outcomes.
- These tumors arise from complex interactions between genetic mutations and environmental factors. However, many cases present without a clearly identifiable cause.
- Ruthenium-106 plaque brachytherapy has emerged as a vital organ-preserving treatment modality for selected intraocular tumors.
- By delivering a focused, high-dose beta radiation directly to the tumor site, this technique achieves excellent local tumor control while sparing surrounding healthy ocular tissues.
- This approach enables most patients to retain their eye and, in many cases, maintain functional vision, representing a significant advancement in ocular oncology care.

Ru-106 plaque brachytherapy exemplifies the pinnacle of targeted ocular cancer therapy - delivering potent tumoricidal radiation while safeguarding the delicate structures essential for vision



FROM REACTOR TO RETINA

Development and deployment of BARC Ru-106 plaque for eye cancer treatment

Bhabha Atomic Research Centre (BARC), India's premier multidisciplinary nuclear research institution, has deployed numerous radioisotopes for a wide range of medical and industrial applications. Ruthenium-106 (Ru-106) radioisotope, the theme of this booklet, is one such notable example. Its unique radiochemical properties make it useful for ocular brachytherapy, offering an effective treatment option for select eye cancers.

The successful development of process for the separation and recovery of Ru-106 in radiochemically pure form and its incorporation into ophthalmic brachytherapy plaques exemplify the translation of advanced nuclear science into affordable, vision-saving healthcare technology. An overview of the process and technology developed for the production of Ruthenium Brachytherapy plaques, starting from recovery of radioisotope to manufacturing of the plaque is described here.

Characteristics of Ru-106

Ru-106, with a half-life of 371 days, decays to

Rhodium-106 (Rh-106) by emitting low-energy (39 keV) beta radiation. The daughter Rh-106 has a short half-life of 30 seconds and exists in secular equilibrium with Ru-106. It subsequently decays to stable Pd-106, emitting high-energy (3.5 MeV max.) β -radiation. This high-energy β -radiation is employed in the treatment of ocular cancers by ophthalmic brachytherapy. A simplified decay scheme of Ru-106 is shown in Fig. 1.

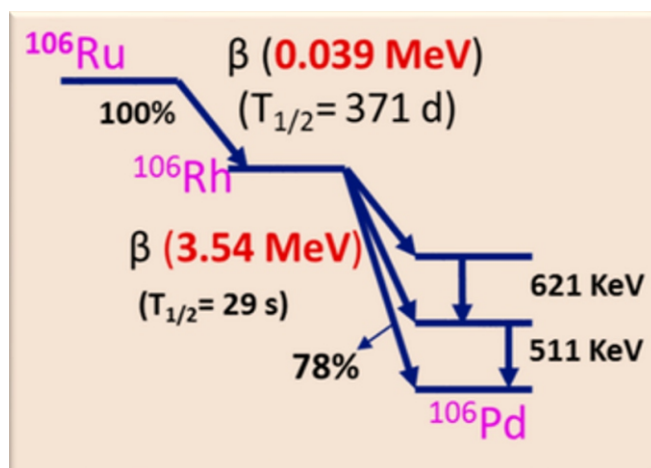


Fig.1: Decay scheme of Ru-106

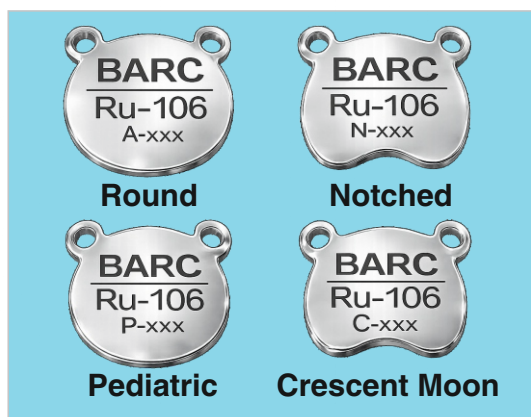


Fig.3: Various configurations of BARC Ru-106 plaque

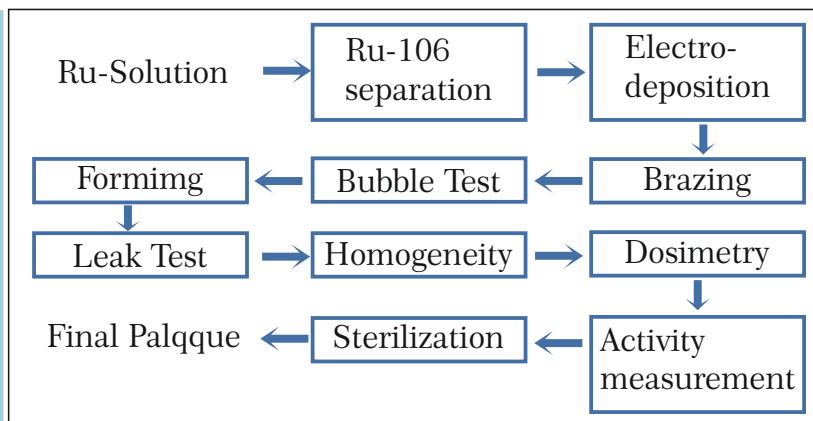


Fig.2: Schematic Diagram of BARC Ru-106 plaque production process.

Source of Ru-106

Ru-106 is one of the many fission products generated during the nuclear fission of uranium-235. The Ru-106, used in plaque preparation, was produced in the Dhruva Research Reactor and subsequently recovered from solution generated during spent nuclear fuel reprocessing. It is further purified following a series of radiochemical separation processes to obtain the high purity required for medical applications.

Plaque Production Process

The steps involved in the plaque production process are presented in Fig.2. All operations are carried out safely and in accordance with stringent regulatory standards.

Plaque configurations

Manufacturing of Ru plaque began with the round configuration, and subsequently, three new configurations were added to meet

treatment requirements (Fig.3). The detailed specifications of the plaques are presented on the last page of this compendium for ready reference.

- **BARC has successfully developed Ru-106 plaque brachytherapy sources.**
- **Till date, 50+ plaques have been supplied to 17 hospitals across India by BRIT.**
- **Each plaque can treat 50 patients.**
- **Ru-106 plaques have completed 500+ successful treatments.**
- **The plaques have gained the trust of the doctors and patients alike**

India achieves self-reliance in Ocular Brachytherapy through the development & deployment of BARC developed Ru-106 plaques



Dosimetric Characterization of the Ru-106 Ophthalmic Plaque

Dosimetry is the bridge between source engineering and clinical application, utilizing the physical characteristics of the Ru-106 plaque for a predictable and safe therapeutic dose. Dosimetric characterization of the Ru-106 ophthalmic plaque begins with the assessment of non-uniformity across the source, a critical quality assurance procedure to assure uniform distribution of radioactivity over the active surface of the plaque. Excessive non-uniformity may result in clinically significant dose variations and is therefore evaluated before detailed dosimetric characterization.

Non-uniformity assessment

The non-uniformity assessment is performed in two stages. Initially, the radioactive source is evaluated in its flat configuration, prior to forming it into the final concave plaque geometry. A two-dimensional

dose distribution is obtained using radiochromic film positioned approximately 1 mm from the source surface. The dose distribution is analysed within a radius of $0.8 \times R50$, where $R50$ is the radius of the 50% isodose contour. This is inline with the recommendations of ICRU Report 72, ISO 21439:2009 and NCS Report 14. After fabrication, the plaque is re-evaluated in its final curved geometry using a high-spatial-resolution silicon diode detector. Measurements are performed at selected locations across the active surface and plaques exhibiting source non-uniformity greater than 20% are excluded from further evaluation.

Depth dose distribution

Following non-uniformity assessment, the non-excluded plaques undergoes comprehensive dosimetric characterization using a dedicated modular phantom developed specifically for

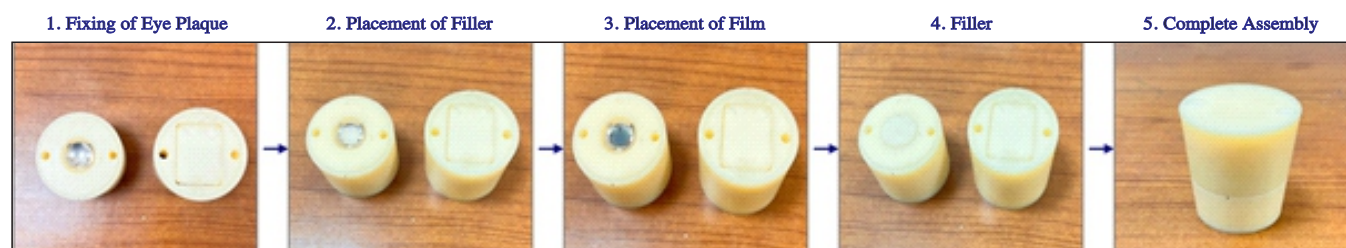


Fig.1: Absolute dose measurement of Ru-106 eye plaques using EBT4 film and a dedicated Phantom

ophthalmic plaque dosimetry. Water-equivalent curved ABS inserts, precisely matching with plaque geometry, positions EBT4 radiochromic films at clinically relevant depths of 1 mm and 2 mm from the inner plaque surface while limiting air gaps and minimizing positioning uncertainties in the region of steep dose gradient (Fig.1). The radiochromic films are irradiated for 30–45 min, depending on the activity of the plaque, and are allowed to stabilize for 24 h before scanning with an Epson make Expression 10000XL flatbed scanner. The scanned images are analysed using dedicated film dosimetry software incorporating a pre-established calibration curve to determine the absolute absorbed dose rates at 1 mm and 2 mm depths.

To characterize the entire depth-dose distribution, the lower section of the phantom, containing the plaque, is placed in a water-filled phantom under full scatter conditions. A high-resolution silicon diode detector is aligned with the plaque central axis. Relative depth-dose measurements are acquired from the plaque surface and subsequently converted to absolute depth-dose values by normalizing the diode response to the film-measured absorbed dose at 2 mm depth (Fig. 2).

The measured depth-dose data are then fitted using regression function, $D(z) = \exp(A + Bz + Cz^2 + Dz^3)$, allowing interpolation of absorbed dose at intermediate depths and extrapolation of the surface dose (0 mm), where direct measurements are impractical because of detector size and perturbation effects. The fitted function also provides an accurate representation of the characteristic steep dose fall-off of Ru-106 beta radiation, enabling the generation of clinically relevant dosimetric parameters for treatment planning, source certification, and regulatory documentation.

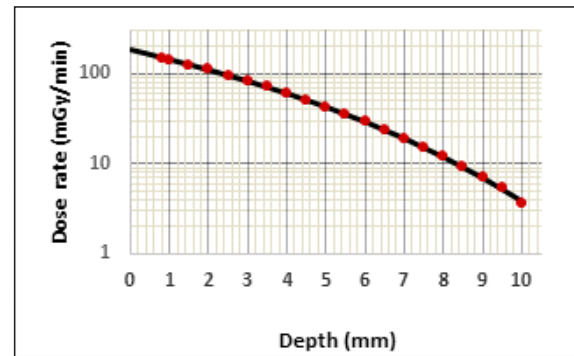


Fig.2: Depth dose profile of a BARC Ru-106 plaque.

- Clinically validated dosimetry methodology based on international standards (ICRU Report 72, ISO 21439:2009 and NCS Report 14).
- Dedicated ophthalmic plaque dosimetry phantom provides geometry-specific dose measurements.
- Complementary dosimetry approach combining radiochromic film and high-resolution diode measurements.
- High-precision absolute and depth-dose measurements at clinically relevant depths (1 mm and 2 mm).
- Complete dosimetric characterization, including absolute and relative central-axis depth-dose profiles, reference absorbed dose rates and surface dose estimation.
- Regression-based depth-dose modelling enabling reliable interpolation and surface dose estimation where direct measurement is not feasible.

Dosimetry is where physics becomes therapy and every calculated dose is a promise of precision





PRECISION SAVES VISION

Determination of Activity in BARC Ru-106 Plaques

The therapeutic performance of Ru-106 eye plaque is fundamentally governed by its radioactive content. Therefore, an accurate measurement of Ru-106 activity is an essential quality assurance requirement, as it directly relates to the absorbed dose delivered to the tumor, the prescribed treatment duration and overall patient safety.

From both engineering and regulatory perspectives, activity measurement provides an independent verification of the manufacturing process by confirming that the electrodeposited radioactivity contains the intended amount of Ru-106. It also validates the consistency of plaque production, supports compliance with regulatory requirements and forms the basis for accurate plaque calibration and reliable patient-specific dose calculations.

Thus, accurate determination of Ru-106 activity is a critical step that bridges manufacturing quality and clinical performance, ensuring reliable plaque calibration, precise dose delivery, and safe, effective ocular brachytherapy. The Ru-106 activity present in the BARC plaque is measured at the Radiation Standards Section (RSS) of BARC. Equivalence of the radioactivity standards of RSS with international standards is established through

regular international inter-comparison programmes organized by the BIPM, the Asia Pacific Metrology Programme (APMP) and the IAEA.

Primary standards, based on 4π β - γ coincidence technique, were indigenously developed and maintained for activity measurements. A high-pressure 4π gamma ion chamber (GIC), which is calibrated using the primary standards, is maintained as a secondary standard for radioactivity measurements.

Methodology

The activity of Ru-106 eye plaques is determined using a well-type, high-pressure 4π gamma ionization chamber (GIC), as shown in Fig.1. The chamber is calibrated using appropriate radionuclide standard sources in a well-defined measurement geometry. For each radionuclide, a sensitivity coefficient (SC, pA/MBq) is established under standard measurement conditions. Sensitivity coefficients for several radionuclides were determined using a standard geometry consisting of 1 mL of radioactive solution contained in an injection glass (IG) vial. The measured SC values were correlated with the average gamma-ray energy of each radionuclide. A calibration curve of sensitivity coefficient against average gamma

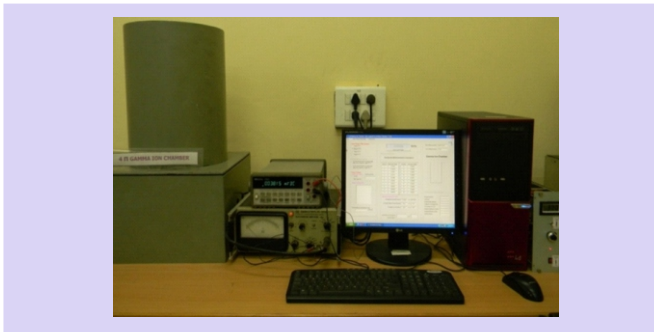


Fig.1: Secondary Standard-GIC system.

energy is generated (Fig. 2). When Ru-106 was being measured for the first time, its SC for 1 mL solution in IG vial was derived from the calibration curve using the principal gamma emissions of its daughter radionuclide Rh-106 with emission abundances greater than 1%, viz 511.8 keV (20.6%), 621.9 keV (9.9%), and 1050.4 keV (1.5%). The derived sensitivity coefficient for 1 mL of Ru-106 solution in an IG vial was 4.30 pA/MBq.

A reference eye plaque source was then prepared by gravimetrically dispensing a known aliquot of the standardized Ru-106 solution onto a blank silver plaque. The deposited solution was dried in a desiccator and the plaque was subsequently sealed to eliminate the possibility of radioactive contamination or material loss. This reference plaque serves as the calibration standard.

The activity of each plaque is determined from the ratio of the measure source current to the SC value. The measured ionization current is corrected for background and radioactive decay to the specified reference date. The long-term stability of the GIC is periodically verified and corrected using a long-lived Ra-226 reference source. Each Ru-106 eye plaque is measured minimum two times over a period of three days to assess measurement repeatability and reproducibility. The average activity value together with the associated measurement uncertainty is reported and an

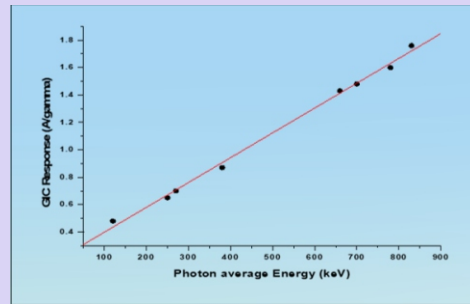


Fig.2: The plot sensitivity coefficient versus average energy of radionuclide.

activity calibration certificate is issued for each plaque prior to clinical use.

- **First-time standardization of Ru-106 in an IG vial.**
- **Sensitivity coefficient established: 4.30 pA/MBq.**
- **Calibration based on Rh-106 gamma emissions.**
- **Reference Ru-106 eye plaque prepared gravimetrically.**
- **Reference plaque adopted as the calibration standard.**
- **Background and decay corrections applied.**
- **GIC stability verified with a Ra-226 reference source.**
- **Duplicate measurements performed over three days.**
- **Calibration certificate issued with activity and uncertainty prior to clinical use.**

***Accurate and reliable
activity measurement is the
cornerstone of safe and
effective ocular
brachytherapy***



QUALITY WITHOUT COMPROMISE

Quality Assurance tests of BARC Ru-106 Plaques

Quality assurance (QA) is the cornerstone of the indigenous production of BARC Ru-106 Plaques. Comprehensive QA tests are performed on every plaque to ensure the highest standards of safety, accuracy, and reliability. The QA program encompasses the evaluation of radionuclide purity, source activity, source uniformity, dosimetric characteristics, encapsulation integrity, and leak tightness. This section focuses on the quality assurance tests conducted to verify the leak tightness of the plaques, a critical requirement for ensuring the safe clinical use of these sealed radioactive sources.

Bubble tests

Bubble test is performed to ensure seal integrity of the Ru-106 plaque in accordance with the AERB Safety Standard (SS-3) guidelines. The plaque is immersed in a hot glycerine bath maintained at 130–140°C and observed for the presence of air bubbles emanating from its surface. The absence of bubbles for a continuous period of 2 minutes confirms that the seal integrity is intact. To ensure reproducibility and reliability, the test is

performed three times on each plaque before it is accepted for further tests.

Leak tests

Each Ru-106 plaque is subjected to three leak tests in accordance with the AERB Safety Standard (SS-3) guidelines, as summarized in Table 1. These tests serve two primary objectives: (i) to verify the integrity of the plaque seal and (ii) to ensure that the plaque is free from removable surface radioactive contamination. The samples collected during each leak test are analyzed using a high-purity germanium (HPGe) detector to quantify radioactivity. A plaque is considered to have successfully passed the leak tests if the total radioactivity content in sample is less than 85 Bq, meeting the prescribed acceptance criteria for clinical use.

Sample Analysis

The leachate solution is transferred into standard calibrated vial corresponding to a predefined geometry for which the empirical efficiency energy calibration of the HPGe

Table 1: Descriptions of leak tests carried out for each plaque.

Test description	Specified test conditions, in brief
Immersion test as per clause 5.1.1.2 of reference code#	Any liquid: Water, vol. 100 ml Temperature: boiling condition Duration: Min 10 min, total 3 times
Immersion test as per clause 5.1.1.1 of reference code#	Any liquid: Vol. 100 ml Temperature: 323 K $\pm$ 5 K Duration: Min 4 h
Immersion test as per clause 5.1.1.4 of reference code#	Water 100 ml
# Reference code: AERB/SS/3(Rev.1)	

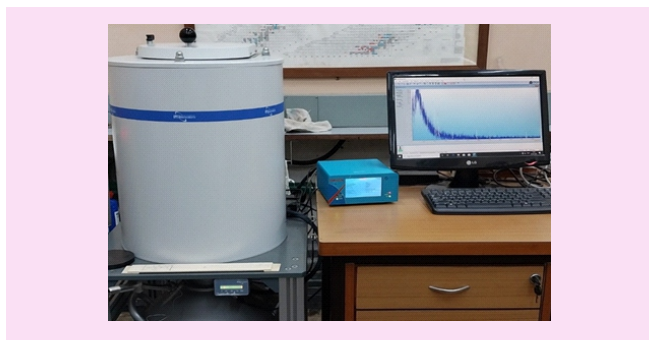


Fig.1: Photograph of HPGe based Gamma Spectrometry System.

detector is established (Fig.1). Each liquid sample was measured for 5000s using an HPGe based gamma spectrometry system to quantify any residual Ru-106. A typical gamma spectrum of the sample is presented in Fig. 2.

Efficiency and Energy calibration of the detector system

The HPGe detector used for activity analysis is regularly energy calibrated using standard gamma sources Ba-133 (81 keV, 356 keV), Cs-137 (662 keV) and Co-60 (1173 keV and 1332 keV). Efficiency calibration was done using Eu-152 NIST standard for vial liquid geometry.

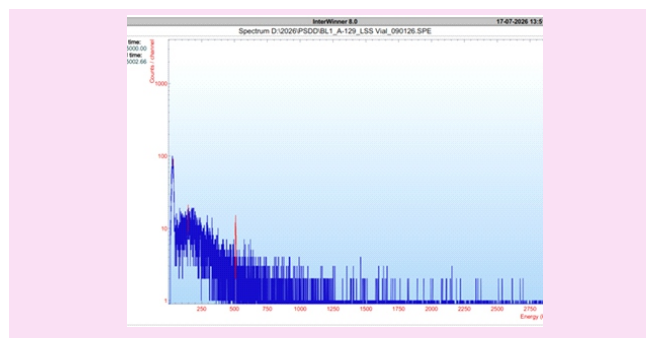


Fig.2: Gamma spectrum of a representative leachate sample.

MDA of the Spectrometer

The HPGe detector system used for the analysis is characterized by its very low minimum detectable activity (MDA), enabling the reliable detection of trace levels of radioactivity. The MDA is calculated using the following equation:

$$MDA = (4.653\sqrt{N} + 2.7) / (t \times \epsilon \times m)$$

Using this methodology, the HPGe system achieves an MDA of approximately 0.1 Bq/mL for a counting time of 5000 s, demonstrating excellent sensitivity for the analysis of leak test samples and ensuring reliable quality assurance of Ru-106 plaques.

- Bubble tests and three leak tests are carried out to ensure leak tightness of the plaque.
- Certified reference standards calibration ensure traceable, accurate, and efficient liquid sample measurements.

Driven by scientific excellence, every plaque embodies precision engineering and an unwavering commitment to patient care



Eye Plaque Simulator: Simulating BARC Ru-106 Plaque Dosimetry for Precision Eye Cancer Treatment

Eye Plaque Simulator is a physics-based simulation application that uses a projected-depth dose model to turn plaque geometry and calibration data into a working planning tool, producing a patient-specific Ru-106 dose plan.

Simulation Methodology

The application builds a complete 3-D eye model with the scleral and retinal ellipsoids, cornea, lens, optic disc, fovea and tumor, all positioned according to a patient's clinical parameters. The Ru-106 plaque (round, notched or paediatric) is placed on the outer scleral surface using the same latitude/longitude convention used at the bedside, so that the simulated geometry closely mirrors the actual implant used in the procedure.

Dose calculation follows a projected-depth dose model (Fig.1). For any point within the eye, the dose rate is obtained from its projected depth along the plaque's central axis, using a depth-dose function that is calibrated from measured dosimetry data. This approach allows the dose to be evaluated on demand at any point in the

eye, rather than only along a single measured line, while still remaining directly traceable back to the plaque's original calibration report.

The depth-dose function is calibrated directly from each plaque's measured dosimetry report. The reference dose rate at 2 mm is read from the plaque's data sheet, the measured curve is scaled to match it exactly, and an exponential tail is fitted beyond the last measured point so that dose at the disc and fovea, well beyond the calibration range, is never overestimated.

Dose & Treatment Duration

For every plan, Eye Plaque Simulator reports dose rate at the six clinically required points viz tumor apex, tumor base, optic disc, fovea, cornea and the maximum/minimum dose within the tumor volume. The latter is estimated by Monte Carlo sampling of 1500 points inside the tumor ellipsoid. Treatment duration is then computed from the prescribed dose (typically 85 to 100 Gy at the apex) divided by the apex dose rate, giving clinicians an immediate, patient-specific implant time.

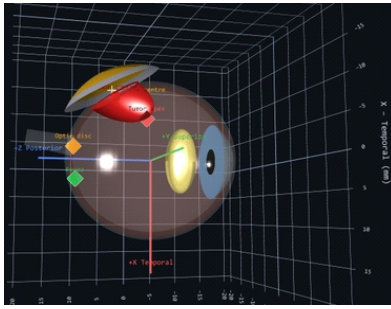


Fig.1: 3-D Geometry Generated by Eye Plaque Simulator's Engine.

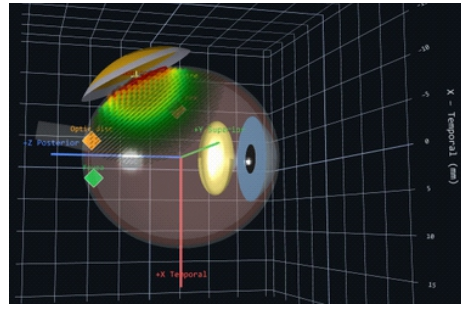


Fig.2: Simulated dose cloud.

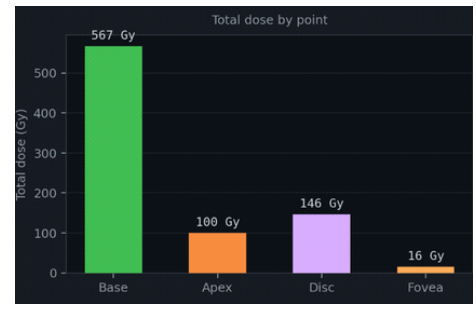


Fig.3: Simulated dose rate at the clinical dose points.

Geometry & Coordinate Engine

Eye Plaque Simulator defines a coordinate system centered on the eye, with dedicated latitude/longitude conventions for tumor & plaque placement and separate azimuthal/elevation conventions for the optic disc and fovea. This lets a planner enter the clinical parameters used on the treatment chart, including tumor location, size & tilt, plaque type and rotation, directly into the simulator without any manual coordinate conversion.

Simulation Outputs

Dose at any field point P is calculated from its projected depth along the plaque's central axis: the scalar projection of P onto the plaque's inward-facing normal, measured from the plaque surface. The dose rate at P is then read directly off the calibrated depth-dose function at that depth: $D(P) = f(d(P))$, in mGy/min. Since this function is derived from each plaque's own measured dosimetry report, dose anywhere in the eye stays traceable back to that calibration data.

Once the apex dose rate is known, treatment duration follows from time equals dose over rate: the prescribed dose (typically 85 to 100 Gy at the apex) divided by the apex dose rate gives the required treatment time in minutes, converted to hours. This gives clinicians an immediate, patient-specific implant duration for every plan.

- Eye Plaque Simulator implements a projected-depth dose model.
- Reports dose rate at six clinically required points: tumor apex, tumor base, optic disc, cornea and fovea and the maximum/minimum dose within the tumor volume.
- Covers round, notched and paediatric plaque configurations in one engine.
- Built for deployment on standard clinic computers, no specialist hardware needed.

Every treatment begins as a simulation: Every rendered dose map is a treatment plan waiting to be trusted



Clinical Applications



Every successful treatment is a victory over cancer and a step toward preserving sight, independence and quality of life

TUMOR TO TRIUMPH

Plaque Brachytherapy for Ocular tumors: Eye Salvage Through Precision Radiation



Centre for Sight(CFS) is committed to deliver the best quality eye care with a personalized touch and cutting edge technology, aimed at achieving overall patient delight. CFS today is poised to provide international quality of evidence-based eye care at an affordable cost with a team of superspecialists who all are world authorities in their areas of focus.

CFS has become India's leading eye care network with 95+ centres across the country, with over 300 ophthalmologists, serving over 15,00,000 patients a year. The Hyderabad centre was conceived in 2013 as a Centre of Excellence in Ophthalmic and Facial Plastic Surgery, Ocular Oncology and Ophthalmic Pathology. We are proud that the Centre has the faculty and infrastructure that can rival the best in the world. The Centre of Excellence has bloomed to its full potential as a resource centre of international reputation for clinical care, research and training in Ophthalmic Plastic Surgery, and Ocular Oncology.

Overview of Plaque Brachytherapy

Dr. Honavar initiated plaque brachytherapy in India in 2004. *He also commissioned the first*

BARC plaque in 2019 and has since used 10 BARC plaques in 260 procedure to date. By delivering a highly conformal dose of radiation directly to the tumor while minimizing exposure to surrounding healthy tissues, plaque brachytherapy achieves excellent local tumor control with high rates of eye salvage and useful vision preservation in appropriately selected patients.

Key Indications for Plaque Brachytherapy

- Choroidal melanoma
- Iris melanoma
- Iridociliary melanoma
- Circumscribed choroidal haemangioma
- Choroidal metastasis
- Retinoblastoma
- OSSN and Conjunctival melanoma with scleral invasion

Principles

Radioactive plaque brachytherapy delivers localized episcleral radiation using a customized plaque sutured over the sclera corresponding to the tumor base. Successful

treatment depends on careful patient selection, multimodal imaging, individualized dosimetry, meticulous plaque localization, and structured follow-up.

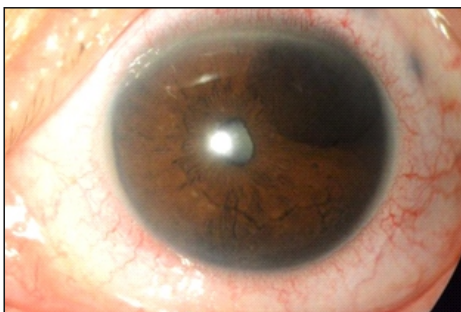
Advantages

- Precise radiation delivery
- Excellent local tumor control
- Eye-conserving treatment
- Useful vision retained in selected patients

What are the results of plaque brachytherapy?

Plaque brachytherapy has excellent success in tumor control with >90% eye salvage in retinoblastoma, melanoma, metastasis and lymphoma. It has nearly 100% success in choroidal hemangioma. The recent application in managing ocular surface squamous neoplasia and melanoma with scleral infiltration has met with spectacular success in eye and vision salvage.

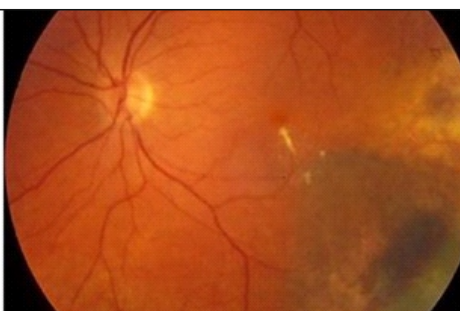
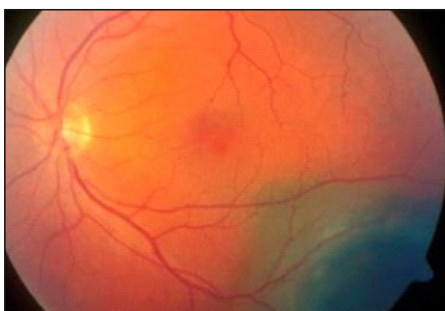
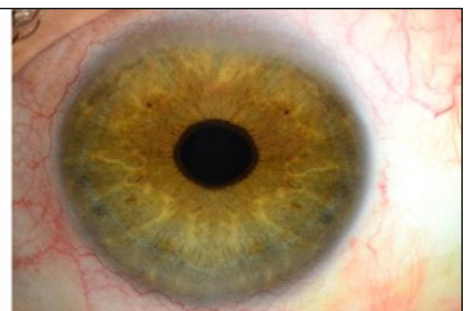
Iris Melanoma



Iris melanoma in a 56-year-old lady (left), regressed following plaque brachytherapy (right).

Iridociliary and Choroidal Melanoma

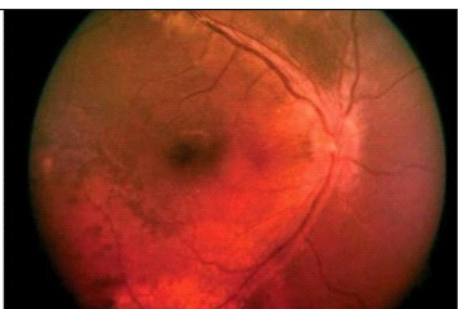
Ciliary body melanoma with iris and angle invasion with hyphema in a 46-year-old lady (left), regressed with 20/30 vision following plaque brachytherapy (right).



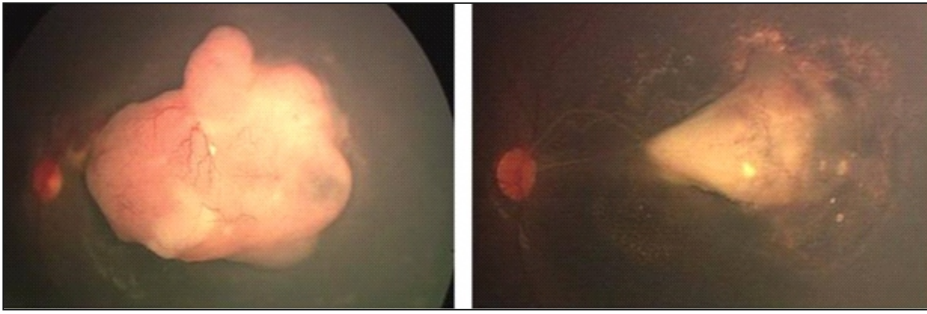
Choroidal melanoma (left) completely regressed following plaque brachytherapy (right).

Diffuse Choroidal Hemangioma

Diffuse choroidal hemangioma with total retinal detachment (left) shows complete regression and resolution of SRF following brachytherapy (right).



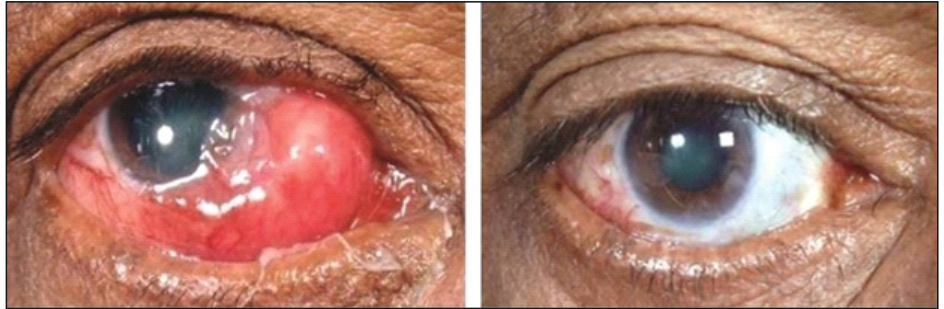
Retinoblastoma



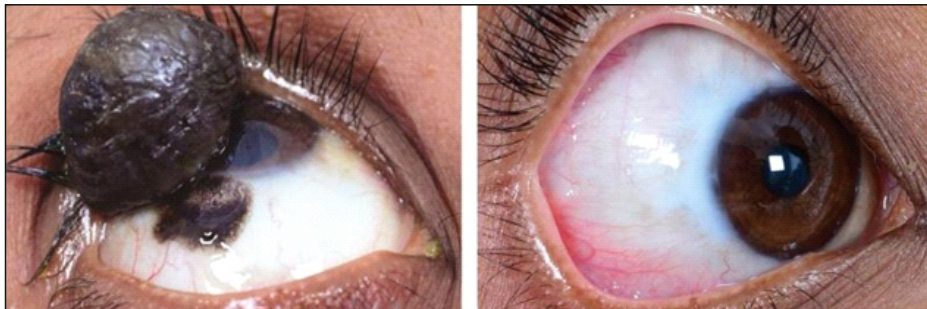
Residual retinoblastoma following chemoreduction (left), effectively treated with plaque brachytherapy with a stable regressed scar at 12 m follow-up (right).

OSSN with Scleral Invasion

Recurrent conjunctival squamous cell carcinoma with scleral invasion (left) shows complete regression following excision and plaque brachytherapy to the scleral base (right).



Conjunctival Melanoma with Scleral Invasion



Recurrent conjunctival melanoma with scleral invasion (left) shows complete regression following excision and plaque brachytherapy to the scleral base (right).

Centre of Excellence, Ocular Oncology

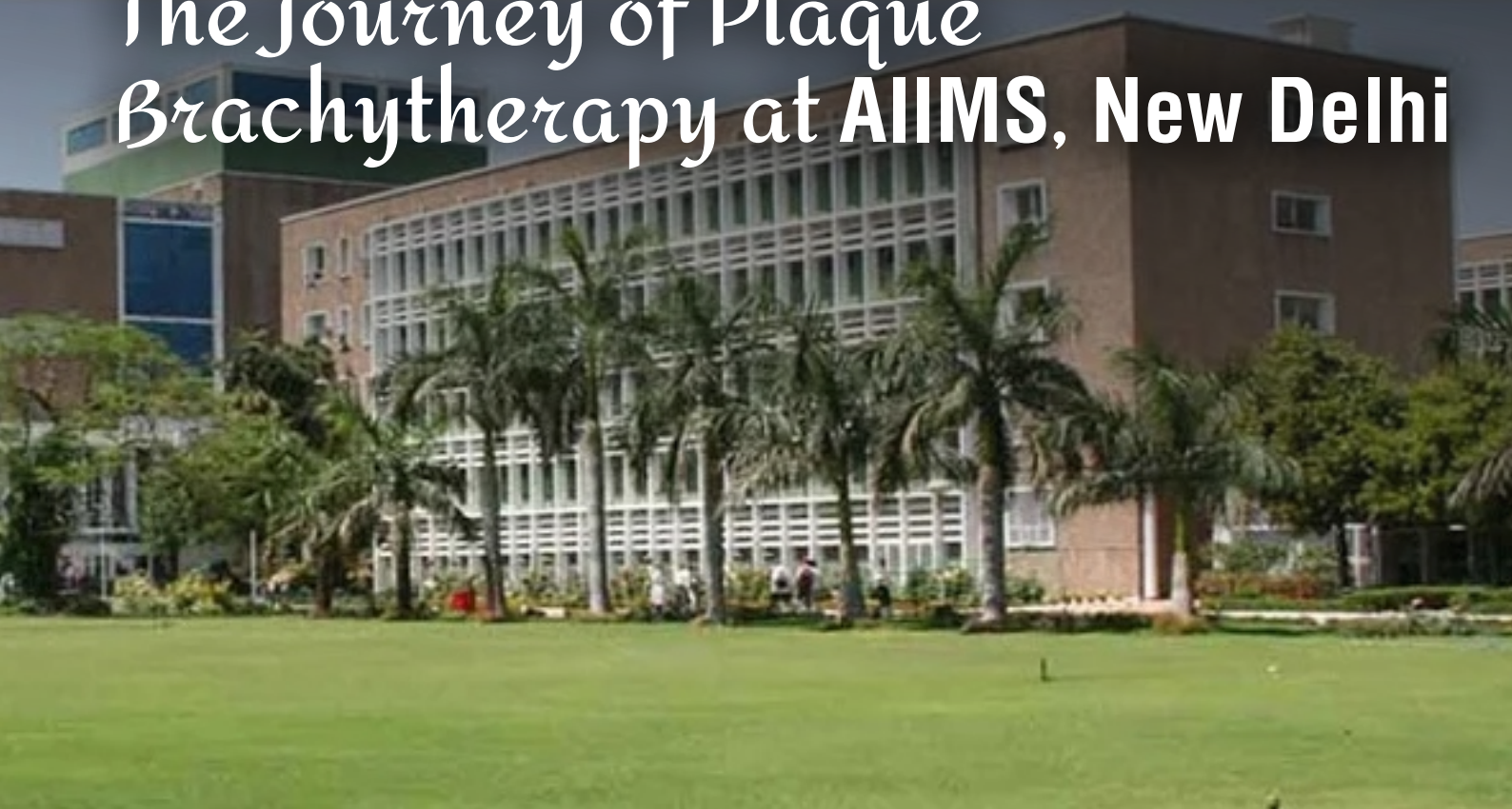
The Centre for Ocular Oncology at Centre for Sight, Hyderabad, is a leading quaternary referral centre dedicated to the comprehensive management of tumors of the eyelid, conjunctiva, intraocular structures and orbit.

The multidisciplinary service integrates advanced diagnostics, plaque brachytherapy, ophthalmic pathology, ocular prosthetics, medical and radiation oncology, and subspecialty surgery with a commitment to evidence-based care, education and research.

*Turning the challenge
of ocular cancer into a
story of healing, hope
and preserve vision*



The Journey of Plaque Brachytherapy at AIIMS, New Delhi



The All India Institute of Medical Sciences (AIIMS), New Delhi, established in 1956 by an Act of Parliament, is an autonomous institution of national importance, founded to advance excellence in medical education, research, and patient care. AIIMS provides comprehensive undergraduate, postgraduate, and super-specialty training across multiple disciplines, conducts high-impact biomedical research, and delivers advanced tertiary healthcare through its multidisciplinary departments.

The Dr. Rajendra Prasad Centre for Ophthalmic Sciences at AIIMS, New Delhi serves as the National Apex Institute for ophthalmic care. The Institute handles a wide spectrum of adult and paediatric eye cancers, providing high quality, specialized, and affordable treatment to patients

from all over the country through a multi-disciplinary approach.

Ru-106 plaque brachytherapy

AIIMS, New Delhi, was the first centre in northern India to establish Ru-106 plaque brachytherapy and has 10 years of experience using BEBIG make plaques (since 2016) and indigenous BARC Ru-106 plaques (since 2020).

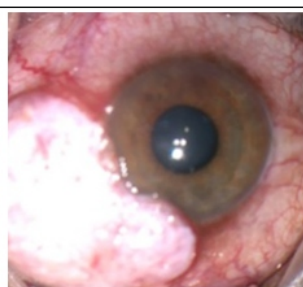
The service operates under strict AERB radiation safety regulations, utilizes a multidisciplinary team, follows a standardized clinical workflow from diagnosis to follow-up, and has evolved from using imported plaques to indigenous BARC technology. Since commissioning in 2017, the program has catered to around 150 ocular tumor



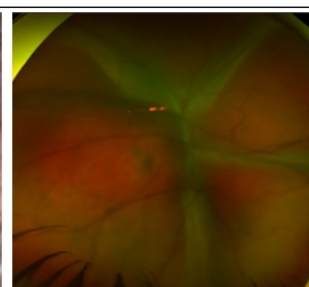
Choroidal Melanoma



Retinoblastoma



OSSN



Choroidal Hemangioma

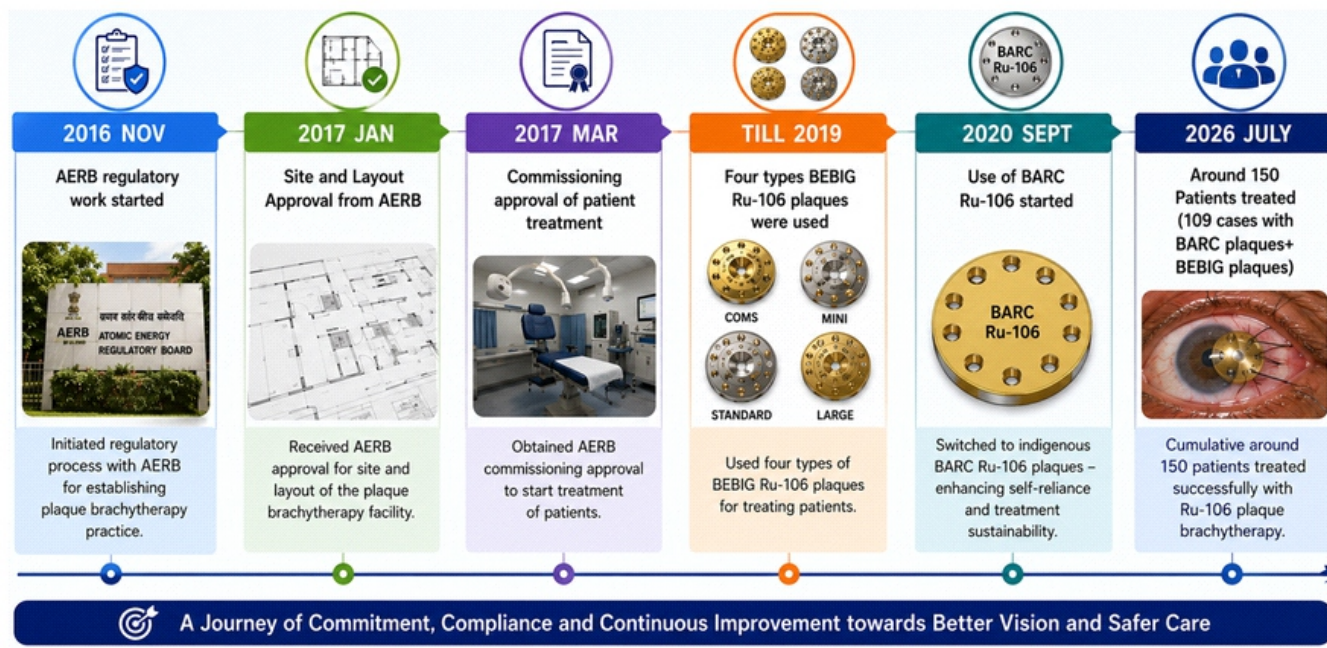


Table 1: Patient Treatment Snapshot.

Sr. No.	Plaque type	Plaque serial number	Number of patients treated
1.	Round	A028	10
2.	Notched	N-12	40
3.	Pediatric	P1	9
4.	Round	A-098	5
5.	Notched	N-125	45

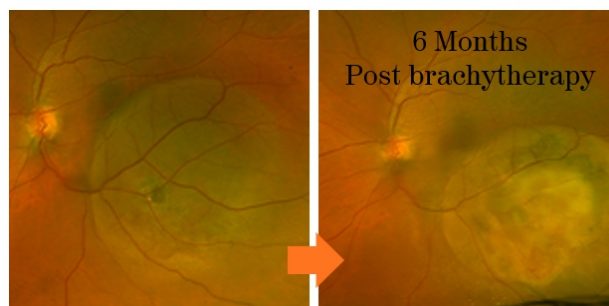


Fig.1: Choroidal Melanoma treated using BARC Ru plaque notched configuration.

patients, demonstrating a mature, safe, and sustainable model for ocular brachytherapy in India. Major indications include uveal melanoma, retinoblastoma, ocular surface neoplasia, conjunctival melanoma & choroidal hemangioma.

A total of 109 patients treated at our centre using BARC Ru-106 plaques and all treatment

were successful. One typical case using BARC notched plaque presented in Fig.1, resulted in marked tumor regression, reducing apical thickness from 5.2 mm to 2.75 mm and basal diameter from 12.9 mm to 7.7 mm. It is noteworthy that *AIIMS New Delhi is the first hospital to initiate BARC Ru-106 pediatric plaque for the treatment of retinoblastoma.*

Transforming indigenous nuclear science into affordable, eye-preserving cancer care—bringing hope, healing, and a better quality of life



Ru-106 Plaque Brachytherapy Experience from Sankara Eye Hospital, Bengaluru

Sankara Eye Hospital, Bengaluru, is a 225-bed tertiary eye care and training centre established in 2008 by Dr. R. V. Ramani under the Kanchi Kamakoti Medical Trust. Guided by its unique 80:20 service model, the hospital provides free comprehensive eye care to nearly 80% of patients, with the remaining 20% of paid services sustaining this charitable mission. The Ocular Brachytherapy Unit, established in 2010 with support from the Krishnarpanam Naraindas Morbai Budhrani Trust, is a leading centre for eye-conserving treatment of ocular tumors. The Ocular Oncology and Vitreo-Retina Services are led by Dr. Mahesh P. Shanmugam, a pioneer in specialized ocular oncology and vitreoretinal care in India.

Ru-106 plaque brachytherapy

Ru106 plaque brachytherapy is an effective eye preserving radiation treatment for selected intra-ocular tumors. It is commonly used in the management of Uveal melanoma, Retinoblastoma, Choroidal haemangioma and selected cases of other ocular malignancies, including Conjunctival lymphoma. This treatment provides excellent local tumor

control while preserving the eye and, in many cases, useful vision.

- Ru-106 plaque brachytherapy was introduced at our hospital in 2010 using BEBIG make Ru-106 ophthalmic plaques.
- Since 2020, the hospital has been using BARC Ru-106 ophthalmic plaques, developed by the Bhabha Atomic Research Centre (BARC), India.

Ocular Surface Squamous Neoplasia



Fig.1: Raised, vascular, reddish lesion on the conjunctiva and it extends onto cornea with surface irregularity.

Fig.2: There was complete regression of the lesion with restoration of a smooth ocular surface.

No recurrence on follow-up shows plaque brachytherapy has effective in controlling OSSN growth.

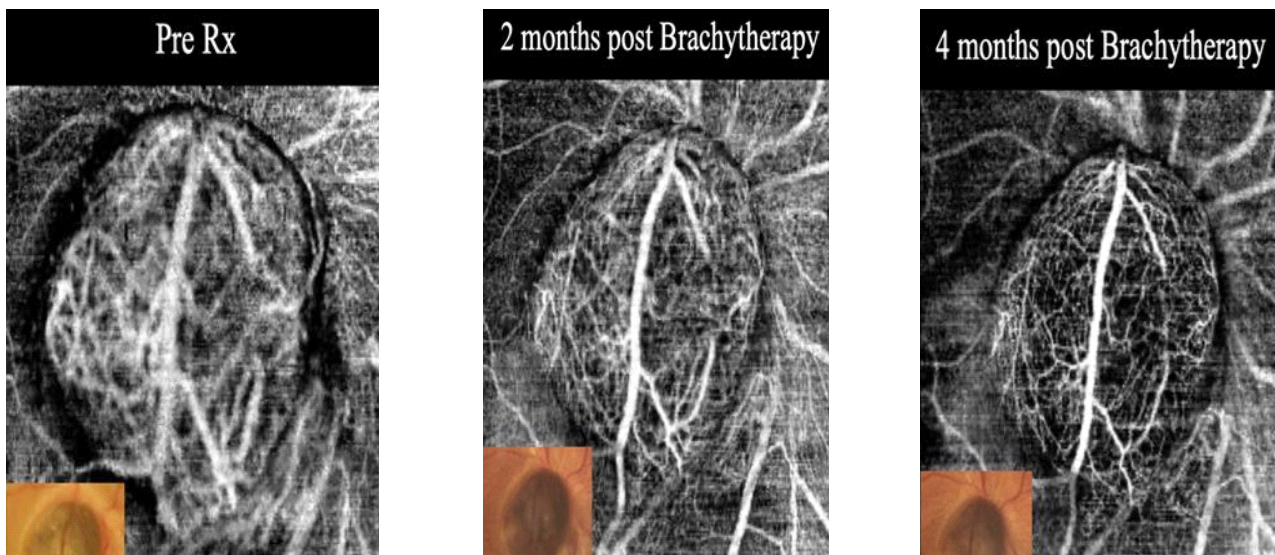


Fig.3: Serial OCT Angiography Demonstrating Tumor Regression Following Ru-106 Plaque Brachytherapy.

Pre-treatment

- Dense intrinsic tumor vasculature with numerous thick, irregular vessels.
- Color fundus photograph shows a pigmented melanoma adjacent to the optic disc.

2 Months Post-Brachytherapy

- Noticeable reduction in the tumor vascular network.
- Abnormal vessels become fewer and smaller.
- Overall tumor blood flow is significantly reduced.

4 Months Post-Brachytherapy

- Marked regression of intrinsic tumor vasculature.
- Only a few thin residual vessels remain.
- OCT angiography demonstrates substantial reduction in tumor perfusion, indicating an excellent therapeutic response.

Summary of treatment

To date, four BARC Ru-106 plaques (two round and two notched) have been commissioned for clinical use. Using these plaques, the hospital has successfully treated 92 patients with ocular malignancies through Ru-106 plaque brachytherapy.

*Every follow-up
image tells the
story of precision
therapy at work*



Clinical Experience with BARC Ru-106 Ophthalmic Plaques at Dr. Shroff's Charity Eye Hospital, New Delhi



Dr. Shroff's Charity Eye Hospital (SCEH), New Delhi, established in 1922, is one of India's leading tertiary eye care institutions providing comprehensive ophthalmic services, education, and research. The hospital has a specialized Ocular Oncology Department for the diagnosis and management of eye cancers. Advanced treatment modalities such as tumor excision, topical chemotherapy and plaque brachytherapy are routinely performed.

Vision

To make a significant impact on avoidable blindness by

- Increasing the footprint of quality eye care services for all socioeconomic sections of society
- Achieving excellence in service delivery
- Creating human resource for eye care
- Innovation through research, technology and sustainable models of delivery and contribute to the body of knowledge
- Enabled by effective and sustainable partnerships to reduce health inequalities

Ru-106 plaque brachytherapy

Dr. Shroff's Charity Eye Hospital (SCEH), New

Delhi provides Ruthenium-106 (Ru-106) plaque brachytherapy for the treatment of selected ocular malignancies, including uveal melanoma, ocular surface squamous neoplasia (OSSN), and retinoblastoma etc. The hospital earlier used BEBIG make Ru-106 plaques. From November 2022 onwards, the hospital uses BARC developed Ru-106 ophthalmic plaques to deliver highly localized beta radiation directly to the tumor, minimizing exposure to surrounding healthy tissues. This eye-conserving treatment is carried out by a multidisciplinary team under strict radiation safety and quality assurance protocols to achieve effective tumor control while preserving the eye and vision.

Treatment using BARC Ru-106 Plaques

Till date, four BARC developed Ru-106 plaques (two round and two notched) have been commissioned for clinical use. *Using these plaques, the hospital has successfully treated 81 patients with ocular malignancies through Ru-106 plaque brachytherapy.*

Representative Clinical Cases Demonstrating the Utility of BARC Ru-106 Plaque Brachytherapy

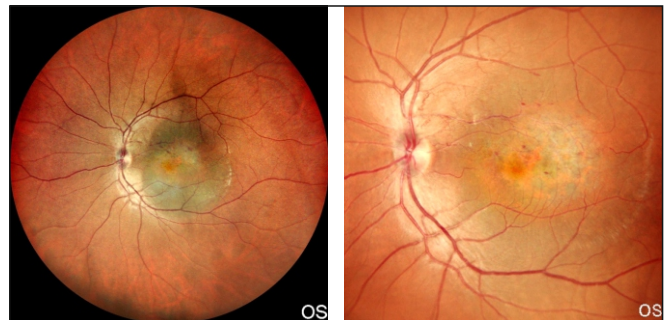
Case 1: Ocular Surface Squamous Neoplasia (OSSN)

- Patient: 54-year-old male
- Presenting Complaints: Pain, watering, and blurred vision
- Diagnosis: Ocular Surface Squamous Neoplasia (OSSN)
- Treatment: Surgical excision followed by Ru-106 plaque brachytherapy
- Outcome: The patient showed symptomatic improvement with a stable ocular surface and no evidence of tumor recurrence during follow-up.



Case 2: Circumscribed Choroidal Hemangioma

- Patient: 42-year-old male
- Presenting Complaint: Reduced vision
- Diagnosis: Circumscribed Choroidal Hemangioma
- Treatment: Ru-106 plaque brachytherapy
- Outcome: The patient demonstrated improvement in visual acuity along with significant clinical tumor regression on follow-up.



Every preserved eye is a testament to the precision of Ru-106 plaque brachytherapy



Eye Cancer Treatment at Malabar Cancer Centre, Thalassery, Kerala



Malabar Cancer Centre, a Post Graduate Institute of Oncology Sciences and Research Centre, is an autonomous institution under the Health and Family Welfare Department, Government of Kerala, established under the Societies Registration Act XXI of 1860. The institution is located at Kodyeri, Thalassery in Kannur District and was established in 2001. Ocular Oncology division was started in 2022 at our hospital.

Ru-106 plaque brachytherapy

Plaque brachytherapy for ocular cancers was initiated at our centre using indigenously developed BARC Ru-106 eye plaques. Some of the important milestones of our journey are highlighted below:

- 24 July 2023: Acquisition of the first BARC Ru-106 plaque (Round type A-082).
- 17 February 2024: First patient treated using plaque brachytherapy—a case of ciliary body melanoma. The post-treatment outcome has been highly encouraging, with no treatment-related complications and no evidence of tumor recurrence on follow-up.
- July 2024: Acquisition of the second plaque, a notched type N-94.

- 24 August 2024: First patient treated using the N-94 notched plaque.
- 26 May 2025: Acquisition of the third plaque, Notched type N-255.
- 27 October 2025: First patient treated using the N-255 notched plaque.
- 4 July 2026: Acquisition of the fourth plaque, Round type A-153.

The progressive utilization of multiple BARC Ru-106 plaques reflect the growing confidence in indigenous plaque brachytherapy and its successful integration into the management of ocular malignancies, enabling treatment for a wider range of tumor locations and sizes.

Summary of Patients Treated

To date, 11 patients have undergone a total of 12 plaque brachytherapy sessions using BARC Ru-106 eye plaques. The treated cases include:

Ocular Surface Squamous Neoplasia (OSSN): 4 patients

Retinoblastoma: 4 patients

Ciliary Body Melanoma: 2 patients

Choroidal Melanoma: 1 patient

Choroidal Hemangioma: 1 patient



Fig.1: Photographs of a patients before and after treatment using Ru plaque.

The initial clinical outcomes have been encouraging, with successful plaque implantation, satisfactory tumor control, and an acceptable safety profile.

Every Treatment Has a Story. Every Story Inspires Hope

This is a case history of a 79-year-old gentleman who presented with swelling of the left eye. Initially given topical medications, but rapidly increasing in size- 7×4 mm scleral mass close to the temporal cornea with congestion. He underwent biopsy and amniotic membrane grafting outside. Slide review at our centre was consistent with SCC. He was treated with BARC Ru 106 notched plaque N-255 delivering about 50 Gy at 2 mm on 21/03/2026. Treatment duration was 15 hours 47 minutes. Fig.1 shows the photograph of the eye before, during and after treatment. Complete disappearance of the tumor mass is visible. No post op complications was reported, confirming the success of the treatment modality.

Achievement

Thalassery Malabar Cancer Center has succeeded in a rare achievement in cancer

treatment. Ocular plaque brachytherapy was successfully performed at MCC. This is a cancer treatment method that preserves the vision without removing the eye. The surgery was successfully performed on a 55-year-old woman suffering from uveal melanoma. The treatment was performed using Ru-106 plaques manufactured by Bhabha Atomic Research Centre at a much lower cost than imported plaques. Chief Minister Pinarayi Vijayan and Health Minister Veena George congratulated the entire team that led the treatment.



Fig.2: Rare surgery to treat eye cancer without removing the eye; Malabar Cancer Center as a model. Fourth government hospital in India to perform plaque brachytherapy.

**Indigenous Ru-106
plaque brachytherapy:
transforming nuclear
science into sight-
preserving cancer care**



PRESERVING VISION: SAVING LIVES

Eye Cancer Treatment at Max Super Speciality Hospital, Saket, New Delhi



Max Super Speciality Hospital, Saket, is a 500+ bed JCI- and NABH-accredited tertiary care centre in South Delhi, part of the Max Healthcare network. Since 2006, the hospital has treated over 34 lakh patients across more than 30 specialities. The Ophthalmology department works in close coordination with Radiation and Medical Oncology teams, giving patients access to integrated, multidisciplinary Ocular Oncology care, including Ru-106 plaque brachytherapy, under one roof.

Our Goal

To preserve vision and the eye wherever clinically possible, offering every patient with ocular cancer access to safe, effective, and affordable eye-saving treatment through close collaboration between Ophthalmology and allied Oncology Services.

Ru-106 plaque brachytherapy

Ru-106 plaque brachytherapy is offered at Max Super Speciality Hospital, Saket, as an eye- and vision-preserving treatment for choroidal melanoma, Retinoblastoma and other

intraocular tumors. The Ophthalmology team works in close coordination with Radiation Oncology to plan and treat each case. Indigenously developed Ru-106 plaques manufactured by the Bhabha Atomic Research Centre (BARC) are used, delivering precise, localised radiation to the tumor while sparing healthy ocular tissue and avoiding enucleation in suitable cases.

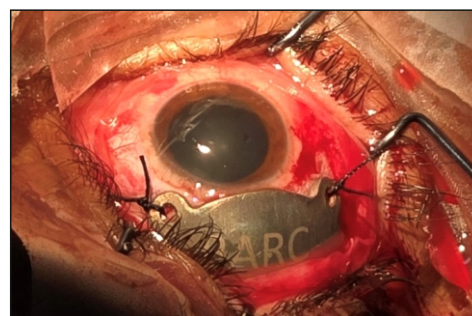
Summary of Patients Treated

BARC-supplied Ru-106 plaques

- *Ru- 106 Notched (N type) Eye Plaque*
- *Ru- 106 Round (A type) Eye Plaque*

Coordinating departments: Ophthalmology & Radiation Oncology

Number of patients treated: 3





Pre-op: 2 conjunctival masses



Post-op: After surgical excision & Ru 106 plaque brachytherapy plaque.

- We have formed the “Max Eye Cancer Care” Unit comprising of Ophthalmologists, Pediatric & Adult Oncologists, Radiation Oncologists and Radiation physicist Team. We have also included our lead Geneticist & pathologists. We hold workshops and conduct regular tumor Boards for better coordination of treatment.
- Max Hospital has JCI- and NABH-accredited safety and quality standards which are applied across all procedures.
- We have an established radiation oncology infrastructure already serving a full range of solid tumors. Ru-106 Plaque was happily added to the therapeutic options!
- With better coordination and the use of novel therapies like plaque brachytherapy & Intra-arterial Chemotherapy, we are striving towards vision-preserving outcomes in intraocular malignancies.



Surgical team to treat eye cancer in Max Super Speciality Hospital, Saket, New Delhi

The regression of tumor vessels marks the triumph of targeted brachytherapy



FROM FEAR TO FREEDOM — TRANSFORMING LIVES

BARC Ru-106 Eye Plaque at Army Hospital Research and Referral, New Delhi



The development of the indigenous Ruthenium-106 (Ru-106) ophthalmic plaque by the Bhabha Atomic Research Centre (BARC), Mumbai, represents a landmark achievement in Indian ocular oncology. Before its introduction, ophthalmic plaques were imported, making plaque brachytherapy expensive and limiting its availability. The indigenous plaque has made eye-conserving brachytherapy more affordable and accessible across India.

Ru-106 plaque brachytherapy

The indigenous Ru-106 plaque is used for retinoblastoma, choroidal melanoma, choroidal hemangioma, selected metastatic lesions, vasoproliferative tumors and ocular surface squamous neoplasia with scleral involvement.

Institutional Experience

Our hospital has been among the pioneering Armed Forces centers to successfully implement indigenous Ru-106 plaque brachytherapy through collaboration between Ophthalmology and Radiation Oncology. Our published case series demonstrated successful treatment of recurrent retinoblastoma, choroidal hemangioma and ocular surface squamous neoplasia with excellent

local tumor control, globe preservation and no recurrence during early follow-up. This work was among the earliest peer-reviewed reports on the indigenous plaque in India.

Significance

The indigenous plaque is a “Make in India” initiative and has significantly reduced treatment costs while expanding access to globe-preserving ocular oncology services. Our team's experience demonstrates that indigenous Ru-106 plaque brachytherapy is safe, effective and practical for routine clinical use.



Military doctors achieve a rare medical feat, the first successful plaque brachytherapy.

HOPE BEYOND CANCER

Eye Cancer Treatment at Smt. Jayaben Mody Multispecialty Hospital



At Smt Jayaben Mody Multispecialty Hospital, we truly care to make a difference. It became apparent that Ankleshwar GIDC was in need of a healthcare centre for the well-being of its employees during 1970-1980s when it developed to its maximum potential. As there was no government hospital in the area, there was a predictable infrastructural and administrative lag in the healthcare sector. Ankleshwar is geographically distant from cities with top-notch medical and healthcare services.

The solution to this lacuna was addressed by the philanthropy of Mody family and Unique

Group of Companies, in the form of a 25 bed hospital. This was located in GIDC housing quarters, which started serving the society. In 1996, the hospital transformed into a full-fledged pivotal medical and healthcare service provider.

Ru-106 plaque brachytherapy

With persistent efforts of Dr. Tejas Pandya, Dr. Shalin Shah and Mr. Dhandapani Varadhacharry, we established the eye cancer plaque treatment facility in 2025 to address the limited availability of this specialized treatment for patients in Gujarat. The first patient underwent plaque brachytherapy on July 4,

2025, marking the successful launch of this specialized service at our institution.

Within a year, we have treated 9 patients. All treatments were successful. Three cases are shown for illustrative purposes.



Regulatory Requirements for Ocular Brachytherapy Facility

Atomic Energy Regulatory Board (AERB) was constituted on November 15, 1983 under the provisions of the above Act to carry out certain regulatory and radiation safety functions for use of nuclear energy and ionizing radiation in India. AERB publishes regulatory requirements in practice specific Safety Codes and Standards under provisions of Atomic Energy (Radiation Protection) Rules, 2004 [AE(RP)R,2004 promulgated under Atomic Energy Act 1962. AERB ensures these requirements are complied with through its regulatory processes viz. consenting/licensing, safety review/assessment, regulatory inspections, enforcement. AERB has stipulated regulatory requirements for the radiological protection of workers, public, patient and the environment in radiotherapy practice (both teletherapy and brachytherapy) in its Safety Code No. AERB/RF-MED/SC-1 (Rev. 1),2011 on "Radiation Therapy Sources, Equipment and Installation". Requirements on facility layout approval, source procurement, radiation measuring & monitoring devices, qualification and training for key professionals(Radiation Oncologist, Medical Physicist, Radiotherapy Technologist, RSO, personnel monitoring etc. are stipulated in this Safety Code.

Approach for regulation of ocular brachytherapy facility in India

The two most commonly used radioactive sources for ocular brachytherapy are I-125 and Ru-106. Based on clinical requirements, few tens of mCi activity of I-125 sources are used whereas in case of Ru-106, activity is generally upto 1 mCi. There is challenge in viability in operation of standalone ocular brachytherapy facility if full time staff is mandatory as workload for ocular brachytherapy patients are very low. Considering this challenges and low hazard radiation facility, regulatory requirements are less stringent for such facility compared to other radiotherapy facilities. Present AERB Safety Code is not mentioning specific requirements to ocular brachytherapy. However, revised regulatory document (in final stage of issuance) addresses regulatory requirements particularly for standalone facility.

Regulatory requirements for operating ocular brachytherapy facility:

i)Layout approval: Ordinary rooms are adequate for sources storage, procedures room and isolation room for keeping patient after place source during treatment for ocular brachytherapy facility as beta/low energy photon emitting sources are used.

ii)RSO approval: Institution needs to apply for obtaining RSO approval from AERB by nominating qualified candidate. Medical Physicist with radiation safety certification (i.e. RSO-Medical) from AERB recognised agency (i.e. RP&AD,BARC) can be nominated by the institution to obtain approval from AERB to function as RSO. Considering low hazard facility, basic degree in Science with physics as one of the subjects or basic degree in Optometry and Radiation Safety Certification (RSO-Ocular Brachytherapy) from AERB recognised agency (i.e. RP&AD,BARC) are also considered eligible candidate for RSO approval.

iii)Source procurement (Fresh/ replacement): Once facility is constructed as per AERB approved layout and RSO approval obtained from AERB, institution can apply for the procurement permission for AERB approved source model. Procurement permission is issued by AERB based on compliance with requirements.

iv)Licence for operation: The services of key personnel such as ocular surgeon, radiation oncologist and medical physicist to be made available in the facility for carrying out low hazard brachytherapy procedures. Appropriate radiation measuring/monitoring and personal monitoring devices should also be available. Prior to operation of the facility, licence from AERB shall be obtained.

v)Decommissioning/disposal: If facility is no longer intended to be operated then facility needs to be decommissioned and sources to be sent to the disposal agency with prior approval from AERB for disposal/safe management.

a)Safety and Security of sources: Sources received, stored and disposed of shall be accounted for and proper log book to be maintained. There should be appropriate security arrangement of sources during storage till its safe disposal to prevent loss of sources.

b)Release of patient: RSO must ensure that source(s) are removed safely from the patient and accounted before discharging the patient.

BARC Ru-106 Plaques are in service for Treatment of Eye Cancers



Technical Specifications of BARC Ru-106 Plaques

Configuration	 Round	 Notched	 Pediatric	 Crescent moon
BRIT Product code	RUM1	RUMN1	RUM1	RUMN1
AERB product code	21081	21088	21081	21088
Geometrical diameter (mm)	15.8	21	12	16
Spherical Diameter (mm)	24 mm			
Activity (MBq)	16–24	20–30	10–15	15–20
Dose rate at 0 mm (mGy/min)	180–220 mGy/min			
Material of construction	Pure Silver (99.9%)			



Ordering Information:

BARC Ru-106 Plaques are available from
Board of Radiation & Isotope Technology (BRIT).
Visit www.britatom.gov.in for details.



1. Pre-requisite for order placement

Procurement NOC from AERB
(visit AERB site: <https://aerb.gov.in>,
and apply for NOC through
eLORA portal)



2. Order placement

After obtaining NOC, place
procurement order to BRIT
(<https://eportal.britatom.gov.in>).



For order related information, write to:

✉ sales@britatom.gov.in | ☎ 022-68687483/68687484



Nuclear Recycle Corner, BARC Trombay

S I R D

Compiled & Published by

Scientific Information Resource Division

Bhabha Atomic Research Centre, Trombay, Mumbai-400 085, India

BARC Newsletter is also available at URL:<https://www.barc.gov.in>

2026