FLASH Radiotherapy — 15-Minute Slide-by-Slide Script

Slide 1 — Title

Time: 20 sec

"Good morning everyone.
I am Prakash Umbarkar, Senior Radiation Therapist from P. D. Hinduja Hospital, Mumbai.
Today I am going to talk about **FLASH Radiotherapy: Workflow, Safety, and Future Readiness**.
My main focus is not only what FLASH can do, but also whether we are ready to deliver it safely in clinical practice."

Pause.

Slide 2 — Introduction

Time: 25 sec

"In radiotherapy, our goal is simple: give enough dose to control the tumour while protecting normal tissue.
We have already made major advances with IMRT, IGRT, adaptive radiotherapy and proton therapy.
But some tumours remain difficult to treat, and normal-tissue tolerance can limit further dose escalation.
So we need new approaches — and FLASH is one of them."

The slide itself frames FLASH around widening the therapeutic window.

Slide 3 — FLASH: A New Era

Time: 25 sec

"FLASH delivers radiation at an **ultra-high dose rate**, in a very short time.
The proposed benefit is reduced normal-tissue toxicity while maintaining tumour control.
But moving from research to clinical treatment is not simply about increasing the dose rate.
We need new workflows, safety systems, QA, and a well-prepared multidisciplinary team."

Emphasize:

"So the question is: **Are we ready to deliver FLASH safely?**"

Slide 4 — What is FLASH?

Time: 25 sec

"So, what exactly is FLASH?
FLASH radiotherapy uses an ultra-high dose rate, much higher than conventional radiotherapy.
The important concept is the **FLASH effect** — the possibility of protecting normal tissue while maintaining tumour control."

Point to graph:

"This difference between tumour response and normal-tissue damage is what makes FLASH so interesting."

Slide 5 — Wider Therapeutic Window

Time: 20 sec

“This brings us to the therapeutic window.
If FLASH can protect normal tissue, we may potentially have more room to treat the tumour effectively.
In simple words: **more tumour control, with less normal-tissue damage.**
That is the main idea behind FLASH.”

Slide 6 — Earliest Observations

Time: 25 sec

“Interestingly, the idea of ultra-high dose-rate radiation is not new.
Observations were reported as early as 1959 in bacteria, followed by mammalian cells and animal studies.
But research slowed because results were inconsistent, the required doses were very high, and the technology was not ready for clinical use.”

Transition:

“Then came the important rediscovery in 2014.”

Slide 7 — FLASH Rediscovery

Time: 30 sec

“In 2014, Favaudon and colleagues demonstrated a very important finding.
At ultra-high dose rate, there was substantially less lung fibrosis compared with conventional irradiation, while tumour control was maintained.
This became a landmark demonstration of what we now call the **FLASH effect**.”

“Later studies also demonstrated protection in other normal tissues.”

Emphasize:

“This is where FLASH moved from an old observation to a major research field.”

Slide 8 — Conventional vs FLASH

Time: 25 sec

“Here we can see the basic difference.
Conventional radiotherapy usually uses lower dose rates, multiple fractions and a longer treatment time.
FLASH uses an ultra-high dose rate, fewer fractions and delivers the radiation extremely quickly.”

“So the **time scale of treatment changes dramatically**.”

Slide 9 — First Human Patient

Time: 30 sec

“In 2019, FLASH moved into human treatment.
Bourhis and colleagues reported the first human FLASH treatment in a patient with recurrent cutaneous T-cell lymphoma.
The patient received 15 Gy in a single fraction, delivered in approximately 90 milliseconds.”

Pause.

“This was an important milestone because FLASH was no longer only an animal experiment — it had entered the clinic.”

Slide 10 — In-vivo Evidence

Time: 20 sec

“Following the early studies, many preclinical experiments investigated FLASH across different tissues.
The overall message from these studies is that normal-tissue protection has been reported in several organs.”

“But we should remember — these are mainly preclinical findings.”

Slide 11 — Different Organs

Time: 20 sec

“This slide gives us a visual summary.
Protective effects have been investigated in tissues including the brain, lung, skin, bone, muscle, intestine and immune system.”

“So the FLASH effect is not limited to one particular organ.”

Slide 12 — Clinical/Translational Evidence

Time: 20 sec

“Here we move closer to clinical translation.
These studies are important because they help us understand not only whether FLASH works, but also its safety and treatment response in larger biological models.”

“However, we still need stronger clinical evidence.”

Slide 13 — Pig Skin Study

Time: 25 sec

“This example shows preclinical evaluation in a mini-pig.
Conventional and FLASH dose rates were compared, and skin toxicity was followed over many weeks.
This type of study is important because it moves us closer to understanding how FLASH may behave in tissues that are more similar to humans.”

Slide 14 — Cat Clinical Response

Time: 20 sec

“Here we can see a clinical response in a cat treated with FLASH.
The images show the disease before treatment and during follow-up.”

“These studies provided additional evidence supporting further clinical investigation.”

Slide 15 — Clinical Trial Design

Time: 25 sec

“But designing a FLASH clinical trial is not straightforward.
We have many variables — dose, dose rate, dose per pulse, treatment time, fractionation, target volume and normal-tissue response.”

“So we cannot simply take a conventional radiotherapy protocol and change the dose rate.”

Slide 16 — FLASH vs Conventional in Cats

Time: 20 sec

“This randomized study in cats also shows that even the **treatment setup and beam arrangement** can be different between FLASH and conventional radiotherapy.”

“This is important for us as RTTs because positioning, immobilization and delivery workflow may need to be reconsidered.”

Slide 17 — Image / Transition

Time: 10 sec

“So far, we have seen the evidence.
Now the important question is: **why does FLASH work?**”

Pause and move forward.

Slide 18 — Biological Mechanisms

Time: 25 sec

“The exact biological mechanism of the FLASH effect is still not fully established.
Several hypotheses have been proposed, including oxygen depletion, free-radical interactions, DNA damage and immune or inflammatory responses.”

“Importantly, these are still hypotheses under investigation.”

Slide 19 — Oxygen Depletion

Time: 25 sec

“One important hypothesis is oxygen depletion.
FLASH may rapidly consume oxygen in the irradiated tissue.
This could temporarily make normal tissue more resistant to radiation damage.”

“Tumours may respond differently because tumour oxygen levels are often already low.”

Slide 20 — Role of Oxygen

Time: 20 sec

“Oxygen appears to be an important factor.
Studies suggest that the amount of oxygen present can influence the FLASH effect.”

“But we still do not completely understand how oxygen controls this response.”

Emphasize:

“So biology remains one of the major unanswered questions.”

Slide 21 — Radiobiology

Time: 25 sec

“FLASH may also challenge our traditional understanding of radiobiology.
Because the treatment occurs in an extremely short time, processes such as repair, repopulation, redistribution and reoxygenation may behave differently.”

“Dose rate and dose per pulse may therefore become important radiobiological parameters.”

Slide 22 — Factors That Matter

Time: 15 sec

“Now we come to a very important point: **FLASH is not defined only by dose rate.**”

“Several treatment and beam parameters may influence the FLASH effect.”

Slide 23 — Beam Parameters

Time: 25 sec

“These include parameters such as pulse structure, dose per pulse, pulse repetition frequency, irradiation time and total dose.”

“For radiation therapists, this means that understanding the treatment machine and beam characteristics will become increasingly important.”

Slide 24 — Pulsed FLASH

Time: 20 sec

“FLASH delivery can be highly pulsed.
Therefore, we need to understand not only how much dose is delivered, but also **how the dose is delivered in time**.”

“This becomes important for both treatment delivery and dosimetry.”

Slide 25 — Immobilization

Time: 30 sec

“This is particularly important for RTTs.
If a large dose is delivered in milliseconds, there is almost no opportunity to correct patient movement during delivery.”

“Therefore, accurate positioning and immobilization become extremely important.”

“At the same time, technologies such as surface-guided radiation therapy and beam triggering may help us achieve both **accuracy and patient comfort**.”

Strong emphasis:

“For FLASH, **we may have milliseconds to deliver the dose — but we may have only one chance to get the setup right.**”

Slide 26 — FLASH Workflow

Time: 35 sec

“This is where my main topic comes in — the workflow.
FLASH will require coordination from simulation and immobilization, through imaging and treatment planning, verification, machine QA and finally treatment delivery.”

“The workflow will need to be clearly defined before the patient enters the treatment room.”

“And this cannot be the responsibility of one person. It requires the entire multidisciplinary team.”

Slide 27 — Current Challenges

Time: 30 sec

“There are several challenges before FLASH becomes routine clinical practice.”

“First, we need suitable technology.
Second, we need very precise beam control.
Third, conventional dosimetry and QA methods may not be sufficient at ultra-high dose rates.”

“And finally, we still need stronger biological and clinical evidence.”

Slide 28 — Negative Outcomes

Time: 30 sec

“It is also important to discuss the studies that did **not** show a FLASH benefit.”

“Some experiments found no tissue-sparing effect, while others reported increased toxicity or mortality.”

“This tells us that FLASH does not automatically produce tissue protection.”

Very important line:

“The outcome may depend on the tissue, dose, dose rate, beam parameters and experimental conditions.”

Slide 29 — Potential Benefits

Time: 25 sec

“Despite these uncertainties, FLASH has several potential benefits.”

“These include normal-tissue protection, a potentially wider therapeutic window, extremely short treatment time, and possible applications for tumours located close to sensitive organs.”

“But these remain potential benefits and require further clinical validation.”

Slide 30 — Current Status

Time: 25 sec

“So where are we today?”

“FLASH is still in the research and early clinical phase. It is not yet a standard radiotherapy treatment.”

“The field is progressing with electron, proton and other approaches, but we still need reliable dosimetry, beam control, safety systems and clinical evidence.”

Slide 31 — Transition

Time: 10 sec

“So, if FLASH is coming toward clinical practice, what does this mean for us as radiation therapists?”

Slide 32 — Transition

Time: 10 sec

“It means that our role will also evolve.”

“We need to understand the technology, the biology and the complete treatment workflow.”

Slide 33 — Speaker / Expert

Time: 10 sec

“This slide highlights the contribution of experts in the field and the growing international interest in FLASH radiotherapy.”

“This is clearly a multidisciplinary and international area of research.”

Slide 34 — Take-Home Message

Time: 40 sec

Slow down here. This is your most important slide.

“So, what should we take home from this presentation?”

“First, we need a better understanding of **FLASH radiobiology**.”

“Second, as radiation professionals, we need stronger knowledge of **ultra-high dose-rate physics, dosimetry and QA**.”

“Third, we need to understand and standardize the complete workflow — from planning to verification and delivery.”

“And most importantly, FLASH will require close collaboration between radiation oncologists, medical physicists, radiation therapists, biologists and engineers.”

Final emphasis:

“We should not wait for FLASH to arrive before we start preparing for it.”

“Learn today, prepare today, and be ready for FLASH tomorrow.”

Slide 35 — Proton FLASH Treatment Plan

Time: 25 sec

“This slide shows an important point in proton FLASH treatment planning.”

“The target can be positioned in the entrance or plateau region, while the Bragg peak is allowed to pass beyond the patient.”

“This is different from our conventional proton treatment planning approach.”

Slide 36 — FAST-01

Time: 25 sec

“Here is an example from the FAST-01 clinical trial.”

“A proton FLASH transmission beam was used to treat a femoral bone metastasis.”

“The beam passes through the leg, with the Bragg peak outside the body. This demonstrates how proton FLASH planning can be fundamentally different from conventional proton therapy.”

Slide 37 — FLASH vs Conventional Dose Rate

Time: 20 sec

“This graph gives us the simplest way to remember FLASH.”

“Conventional radiotherapy delivers radiation over a longer time. FLASH delivers the prescribed dose at an ultra-high dose rate, potentially in a fraction of a second.”

“That difference in time is central to the FLASH concept.”

Slide 38 — Final Slide

Time: 30 sec

“Finally, why are we interested in FLASH?”

“Because it may provide a biological advantage — protecting normal tissue while maintaining tumour control.”

“It can also make treatment extremely fast, potentially reducing intra-fraction motion and improving patient comfort.”

“But there is one major challenge: **dosimetry and quality assurance at ultra-high dose rates.**”

Final closing:

“FLASH is promising, but it is not yet routine clinical radiotherapy.”

“Our responsibility today is to understand it, prepare for it, and make sure that when the technology becomes clinically ready, **we are ready too.**”

“Thank you.”