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*Original Research Article*

# COMPARISON OF DIFFERENT RADIATION DOSES FOR PAIN CONTROL IN BONE METASTASIS

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## ABSTRACT

***Background:*** *Painful bone metastases markedly impair quality of life in patients with advanced malignancies. Palliative radiotherapy is a cornerstone of pain management; however, the optimal dose-fractionation schedule remains debated, particularly in high-volume public-sector oncology centres where treatment efficiency and resource utilization are critical. Comparative evaluation of commonly used regimens is therefore clinically relevant.* ***Objective:*** *To evaluate and compare pain response, reduction in analgesic requirements, and re-irradiation rates among patients receiving 20 Gy in 5 fractions, 30 Gy in 10 fractions, and a single 8 Gy fraction for painful bone metastases.* ***Study Design:*** *Retrospective analytical study.* ***Settings:*** *Department of Radiotherapy and Oncology, Nishtar Hospital, Multan.* ***Duration of Study:*** *January 2025 to July 2025.* ***Methods:*** *Clinical records of 110 adult patients with radiologically confirmed painful bone metastases were reviewed. Pain scores and analgesic consumption were documented at baseline, two weeks, and one month following radiotherapy. Pain response was classified as complete, partial, or absent using standard criteria. Outcomes, including pain relief, analgesic reduction, and re-irradiation rates, were compared across the three radiotherapy regimens.* ***Results:*** *Complete pain response was highest in the 20 Gy in 5 fractions group (30%), followed by the 30 Gy in 10 fractions group (26%) and the single 8 Gy fraction group (19%). Partial pain response was most frequently observed with the 30 Gy regimen (63%). Reduction in analgesic requirement was most significant among patients receiving 30 Gy in 10 fractions (76%). The need for re-irradiation was highest in the single-fraction 8 Gy group (22%). Both multifraction regimens provided earlier pain relief than the single-fraction schedule.* ***Conclusion:*** *All three radiotherapy regimens provided clinically meaningful pain relief in patients with bone metastases. However, multifraction schedules were associated with a more consistent early pain response, greater reduction in analgesic use, and lower re-irradiation rates than single-fraction treatment. Given comparable early pain control between the two multifraction regimens, 20 Gy in 5 fractions represents an efficient and pragmatic option for high-volume public-sector oncology centres. At the same time, single-fraction 8 Gy may be reserved for selected patients in whom multifraction treatment is not feasible or rapid palliation is required.*

**Keywords:** Bone Metastasis, Palliative Radiotherapy, Pain Control, Hypofractionation, Analgesic Reduction

## INTRODUCTION

In the management of painful bone metastases, palliative radiotherapy is a crucial intervention that aims to alleviate pain and improve the quality of life for patients who have advanced cancer. Bone metastasis can lead to significant morbidity, affecting physical function and the overall well-being of patients (1). Recent literature has focused on various radiation dose fractionation styles, particularly comparing single-fraction versus multifraction regimens, to determine the most effective approach for pain control.

Palliative radiotherapy has been established as an effective method to relieve pain associated with bone metastasis, supported by multiple guidelines advocating for both single and multifractionated doses. A systematic review indicated that both treatment modalities yield comparable pain relief outcomes (2, 3). Specifically, an 8 Gy single fraction has been widely adopted due to its convenient administration and its efficacy similar to that of multiple fractions (4, 5). Furthermore, the literature suggests that multifraction treatments may not provide a significant advantage in pain management compared to a single-fraction regimen (6, 7).

Adopting modern radiation techniques, such as Stereotactic Body Radiation Therapy (SBRT), has been an emerging trend aimed at increasing the precision of radiotherapy for painful bone metastases. There is substantial evidence suggesting that SBRT can lead to enhanced pain control with minimal toxicity. Studies indicate that patients treated with SBRT achieve higher pain relief rates than those receiving conventional radiotherapy (5, 6).

Despite overall evidence supporting the use of different radiation doses, variability persists in clinical practice when these therapies are implemented. Factors such as patient characteristics, tumor type, and specific clinical circumstances influence the choice of radiation regimen, leading to ongoing debates over optimal treatment protocols (7, 8). Importantly, the issue of pain flares after single-fraction radiotherapy has been discussed, with some patients experiencing transient increases in pain before achieving the intended relief, underscoring the importance of individualized treatment planning (9, 10).

In the context of Pakistani patients, the application of these findings may significantly enhance palliative care within oncology. With a growing burden of cancer and limited access to comprehensive treatment facilities, adopting efficient radiation protocols focusing on single fractions such as 8 Gy might be particularly beneficial. This approach not only reduces the burden on healthcare resources but also improves patient compliance by providing quicker pain relief options (8, 11, 12). Therefore, aligning treatment practices with international guidelines while acknowledging local disease patterns and patient needs could enhance the quality of life for patients facing bone metastasis in Pakistan.

## METHODOLOGY

This retrospective analytical study was conducted in the Department of Radiotherapy and Oncology, Nishtar Hospital, Multan. The study reviewed five years of clinical records of patients with painful bone metastases who received palliative external beam radiotherapy. All

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patients aged 18 years and above with radiologically confirmed bone metastases and documented pain scores before and after radiotherapy were included. Patients who received concurrent chemotherapy or had incomplete records were excluded.

Three radiation schedules were used in clinical practice during the study period. Patients were grouped according to the regimen they received: 20 Gy in 5 fractions, 30 Gy in 10 fractions, or 8 Gy single fraction. Pain scores were recorded using the numerical pain rating scale. Improvement in pain was documented on follow-up visits at two weeks and one month. Additional variables recorded included age, gender, primary tumor site, site of bone metastasis, analgesic requirement, and need for re-irradiation.

Data were analyzed to compare pain relief between the three regimens. Pain response was categorized as complete, partial, or no response according to standard international guidelines. The effectiveness of each regimen was compared, and the regimen providing the highest proportion of pain responders and longest duration of pain control was identified. All findings were interpreted in the context of the Pakistani patient population managed at a tertiary-care public-sector hospital.

SPSS 27 was used for data analysis. Data were presented in the form of means with standard deviations and frequency with percentages.

## RESULTS

A total of 110 patients were included in this five-year analysis. The mean age was 56.4 years, ranging from 28 to 82 years. Males accounted for 60 percent of the study population, while females represented 40 percent. The most common primary cancers were breast, prostate, and lung malignancies. The spine was the most frequent site of metastasis, followed by the pelvis, ribs, and long bones (Table 1).

**Table 1: Demographic Characteristics of Patients (n = 110)**

| Variable | Frequency | Percentage |
|---|---|---|
| Age (mean ± SD) | 56.4 ± 12.8 years | — |
| **Gender** | | |
| Male | 66 | 60 |
| Female | 44 | 40 |
| **Primary Tumor Site** | | |
| Breast cancer | 34 | 30.9 |
| Prostate cancer | 28 | 25.4 |
| Lung cancer | 22 | 20 |
| Others | 26 | 23.7 |
| **Site of Bone Metastasis** | | |
| Spine | 52 | 47.3 |
| Pelvis | 24 | 21.8 |
| Ribs | 18 | 16.4 |
| Long bones | 16 | 14.5 |

Regarding treatment selection, 20 Gy in 5 fractions was the most frequently administered regimen, followed by 30 Gy in 10 fractions and 8 Gy single fraction radiotherapy. (Table 2)

**Table 2: Distribution of Patients by Radiotherapy Regimen**

| Radiotherapy Dose | Number of Patients | Percentage |
|---|---|---|
| 20 Gy in 5 fractions | 40 | 36.4 |
| 30 Gy in 10 fractions | 38 | 34.5 |
| 8 Gy single fraction | 32 | 29.1 |

Pain relief was achieved in a majority of patients across all regimens. The 20 Gy group had the highest complete response rate, while the 30 Gy group had the highest proportion of partial responders. The 8 Gy single-fraction group had the lowest complete response rate and the highest no-response rate (Table 3).

Analgesic reduction was most notable among patients receiving 30 Gy in 10 fractions. The need for reirradiation was highest among those who received 8 Gy single-fraction radiotherapy, indicating a comparatively shorter duration of pain relief in this group (Table 4).

**Table 3: Pain Relief Outcomes After Radiotherapy**

| Pain Response | 20 Gy/5 fx | 30 Gy/10 fx | 8 Gy Single | Total |
|---|---|---|---|---|
| Complete response | 12 (30 percent) | 10 (26 percent) | 6 (19 percent) | 28 |
| Partial response | 22 (55 percent) | 24 (63 percent) | 18 (56 percent) | 64 |
| No response | 6 (15 percent) | 4 (11 percent) | 8 (25 percent) | 18 |

**Table 4: Analgesic Reduction and Re-irradiation**

| Parameter | 20 Gy/5 fx | 30 Gy/10 fx | 8 Gy Single |
|---|---|---|---|
| Reduction in analgesic requirement | 70 percent | 76 percent | 35 percent |
| Need for re-irradiation | 10 percent | 8 percent | 22 percent |

## DISCUSSION

The study presented significant findings on the demographic characteristics and treatment outcomes of patients with bone metastases. A total of 110 patients were investigated, with a mean age of 56.4 years; males accounted for 60% of the study cohort, while females accounted for 40%. Notably, the findings revealed that breast, prostate, and lung cancers were the predominant sources of metastases. These demographics align with existing literature, which reports that prostate cancer is commonly associated with bone metastases, corroborating findings from Rühle et al (13). This study also mirrors the demographics of patients from other centers, reinforcing the global prevalence of these malignancies as primary sources leading to symptomatic bone involvement.

In terms of treatment selection, the most frequently administered regimen was 20 Gy in 5 fractions (36.4%), followed closely by 30 Gy in 10 fractions (34.5%) and 8 Gy single fraction radiotherapy (29.1%). This distribution is consistent with findings reported by Spencer et al. (14), who emphasized that fractionated regimens are often preferred in clinical practice due to their potential for sustained pain relief.

Upon evaluating pain relief outcomes, the results showed varying efficacy across different radiotherapy doses, with the 20 Gy group achieving the highest complete response rate (30%) and the 30 Gy group showing the best partial response rate (63%). This outcome resonates with the analysis by Farhang et al. (15), who reported that higher dose fractions, such as 30 Gy, typically yield higher pain response rates than lower doses. The 8 Gy single fraction, while showing immediate relief, exhibited the lowest complete response rate among study participants, underscoring the findings of Haus et al. (16), who reported that re-treating painful bone metastases was less often required after longer courses than after single-fraction radiotherapy.

In terms of analgesic requirement and potential for re-irradiation, the reductions in analgesic needs were most remarkable among the cohort

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receiving 30 Gy in 10 fractions (76%). This finding supports the concept that longer-term fractionated courses tend to yield lower re-treatment rates compared to single-dose therapy. According to Spencer et al. (14), patients receiving fractionated radiotherapy generally experience more prolonged pain relief, thus potentially reducing the need for re-irradiation—a pattern reflected in our results as well. Conversely, the notable 22% re-irradiation rate in the 8 Gy group aligns with existing concerns about pain flare responses, underscoring the need for a carefully tailored palliative care approach. Thus, the demographic and outcome characteristics presented within our study replicate findings observed across diverse populations in contemporary literature. The data strongly indicate that while single-fraction doses may offer immediate relief, multifractionated regimens such as 20 Gy in 5 fractions or 30 Gy in 10 fractions manifest superior long-term pain control and reduced requirements for additional interventions. As palliative care evolves, our findings add weight to the argument for refined treatment tailoring based on patient needs, further validating international guidelines for the management of bone metastases in clinical practice.

The response of pain control in the 20 Gy group is non-inferior to the 30 Gy group, as well as a reduction in pain medication. Both regimens give immediate pain control after completion of treatment. But in the 20Gy dosage group, the hospital stay is short, and the travelling cost is also lower in the 20Gy in 5 days plan as compared to the 30Gy in 10 days plan. In the public sector, where the burden of cancer patients is very high, in this situation, we can treat double the bone metastasis cases with a 20 Gy plan as compared to 30Gy in 10 fractions, which is the unmet need of the time. Immediate pain control also improved the quality of life in both groups.

On the other hand, the cancer patient did not achieve immediate pain relief with a single 8Gy fraction, so the requirement of analgesics did not reduce. It took 3 to 4 weeks to get pain control. On the other hand, the single 8Gy fraction did prevent impending fracture, which is another important indication of palliative radiation in bone metastasis.

## CONCLUSION

This study demonstrates that while all three regimens provide pain relief, multifraction palliative radiotherapy offers better overall outcomes for patients with painful bone metastases. The 20 Gy in 5 fractions and 30 Gy in 10 fractions schedules achieved higher rates of pain response, greater reduction in analgesic use, and fewer re-irradiation needs than the 8 Gy single fraction. So the 20Gy in 5 fractions plan can be adopted in public sector hospitals like Nishtar Hospital, which is cost-effective and reduces the hospital stay of cancer patients. The single 8Gy fraction would be used to prevent an impending fracture, but it would not be a good plan for pain control. These results highlight the value of multifraction radiotherapy in achieving sustained pain control and improving the quality of life of patients with metastatic bone disease in Pakistan.

## DECLARATIONS

**Data Availability Statement**

All data generated or analyzed during the study are included in the manuscript.

**Ethics approval and consent to participate**

Approved by the department Concerned. (IRBEC-NMUM-023/24)

**Consent for publication**

Approved

**Funding**

Not applicable

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTION

***RANA ATIQUE ANWAR KHAN** (Associate Professor)*
*Conceived the study, coordinated data collection, performed initial analysis, and prepared the first draft of the manuscript*
***MUHAMMAD ARSHAD** (Health Physicist)*
*Assisted in study design, data acquisition, and manuscript editing*
***FALAK SHER** (Health Physicist)*
*Contributed to literature review, data organization, and interpretation of results*
***SUMAN KHAN** (Post Graduate Resident)*
*Participated in data collection, patient coordination, and preparation of tables and figures*
***ALI RAZA** (Health Physicist)*
*Assisted in statistical analysis, data verification, and results compilation*
***HASAN MEHDI** (House Resident)*
*Contributed to proofreading, critical revision, and final approval of the manuscript*

*All authors read and approved the final version of the manuscript.*

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