Research article

A comparative study to evaluate the feasibility and efficacy of use of mehendi vs temporary pen markings for skin marking in patients undergoing conventional external beam radiotherapy with Cobalt 60 machine

Suparna Kanti Pal¹, Sumana Maiti Das², Neena Prasad S.³, Kunal Kishor Gupta⁴, Siddhartha Basu⁵

¹Assistant Professor, Department of Radiotherapy, Bankura Sammilani Medical College, Bankura West Bengal, India ²Assistant Professor, ^{3,4}Resident, ⁵Professor, Department of Radiotherapy, Institute of PostGraduate Medical Education and Research, Kolkata, West Bengal, India

(Received: February 2020 Revised: February 2021 Accepted: March 2021)

Corresponding author: Sumana Maiti Das. Email: drsumanadas@gmail.com

ABSTRACT

Introduction and Aim: The most common practice for marking the radiation field borders in conventional radiotherapy is with marker pens. In the hot and humid environment in India these markings rapidly fade and require remarking. In some cases, they require re-simulation and re-planning. Mehndi has been used in India for ceremonial marking on skin for long. Here we seek to evaluate the same for radiotherapy.

Materials and Methods: Eighty-two patients with no history of hyper-sensitivity to mehendi were scheduled to be analyzed on per protocol treatment basis, with 41 in each arm. Subjects were randomized by lottery method till the target number in one of the arms is reached. Since one subject in each arm had not received the per protocol management due to default, two more subjects were included and randomized. The minimum duration of treatment was 5 weeks. Markings were done either with mehndi cones (Arm A) or conventionally used Skin marking pens. They were repeated as per requirements. The number of application and gap between them were recorded. The data was later analyzed with SPSS v23 for frequencies, independent sample T test, including Mann-Whitney test. The analysis was per protocol.

Results: No incidence of hypersensitivity to mehendi occurred. The mean and median number of applications was significantly less in the Mehndi arm compared to control arm (median being 2 in mehndi arm compared to 4 in Pen arm). The median gap between applications and each application was also significantly lower in the Mehndi arm (11.5 days vs 7.25 days). There was no significant difference with visualization. The comfort level of the technologists, consultants and patients were better with Mehndi than with pen arm on Likert scale.

Conclusion: Mehndi is more durable than the pen marking it is equally visible for health care professionals and more comfortable to patients. The skin tone of our patients did not pose any challenge in visualization during set up either in ambient lighting or with lasers.

Keywords: Mehendi; skin markings; external beam radiotherapy.

INTRODUCTION

adiation therapy is the most common and effective method for treatment of cancer. In India Majority of the radiotherapy is delivered by Cobalt 60 beam with conventional technique. Treatment delivery by Cobalt 60 conventional technique requires marking of the field borders on the skin surface unlike the conformal technique where only three reference points are required. This is generally done by marker pens available in the market. Unfortunately, these markings are not indelible, and they wash off with even one wash or even sweat, especially in the summer season. Therefore, the patients had to instructed not to put water in those areas throughout the radiation period which varies at an average from 5 to 7 weeks i.e., nearly two months. This entails a very difficult task for the patient especially in the summer season to go without a bath. Moreover, despite best efforts the markings fade within a few days and in our experience the markings have to be repeated at least every week. If by any reason the markings are totally removed that happens quite often for no fault of the patients, the whole process of simulation has to be repeated. This means not only machine time or extra burden of work for the technician and oncologist and the physicist but also that the patient would be getting extra CT scans leading to unnecessary doses of radiation. Moreover, this loss of time often leads to break in RT for a day or two. Such break leads to accelerated repopulation and reduction in efficacy of the treatment especially in tumors with smaller spot or tumor doubling time. We had tried to obtain the indelible ink pen manufactured by Mysore Paints and Varnishes for Election commission of India from the manufacturers as well as their third-party listing, but no response was available.

In this study we compared the use of Mehndi which is often used in India for ceremonial tattooing as an alternative to pen makers and see the feasibility & efficacy of the same.

MATERIALS AND METHODS

Patient inclusion

Adult patients who are scheduled to receive External beam radiotherapy in cobalt 60 machine by conventional planning for a duration of at least 5 weeks were offered to be part of the study. Patients with any known skin reactions/ hyper-sensitivity in the past to henna or mehndi were excluded from the study. Once they have given informed consent, they were randomized by lottery method to Arm A (mehndi) and arm B (pen marking) till one of the arms were full.

Sample size calculation

The sample size is calculated based on accommodating for a Type I error 5%, power of the study – Not less than 90%, possibility of attrition at 20% for providing the maximum margin of validity and a sampling ratio of 1.

The mean duration of usage for pen markers have been about 8 days while that about mehendi in earlier literature referred to earlier is about 12 days while the standard deviation being 5 days.

 $\begin{array}{c} nA{=}\kappa nB \text{ and} \\ nB{=}(1{+}1{/}\kappa)[\sigma \left(z1{-}\alpha{/}2{+}z1{-}\beta \right) / (\mu A{-}\mu B)]2 \\ \text{ when } \end{array}$

- $\kappa = nA/nB$ is the matching ratio
 - σ is standard deviation
 - α is Type I error

• β is Type II error, meaning $1-\beta$ is power Thus, the calculated sample size per arm works out to be 33 *1.25= 41.25~ 41.

Study Period: From July 2017 to January 2018.

Treatment planning and skin marking

Patients were planned as per requirement of their disease status in conventional manner for all patients.

In case of Arm A, the field border markings on the skin were done with commercially available Mehndi cones. The patients had to lie down for 60 minutes after application to give time for set up. They were advised not to apply water for the next 24 hours (one day) and then could have usual bath without scrubbing the local area.

In case of Arm B, the field borders were marked with skin marking pens. They were advised not to apply any water in the local area for the whole duration of radiotherapy.

The markings were inspected every alternate day for both the arms during radiation and reapplication was done as and when deemed fit by the investigators.



Fig. 1: Consort diagram of the trial



Fig. 3: Mehndi marking on skin for a subject for head and neck radiotherapy

The number of application and gap between them were recorded. The data was later analyzed with SPSS v23 for frequencies, independent sample T test, including Mann-Whitney test. The analysis used was per protocol analysis.

We used Felix von Luschan skin color chart(1; fig.4) to document skin shades and then compare with the Visibility opinion of technicians, Residents, and consultants both in planning room and treatment room with ambient lighting and with laser. The laser

used was wall mounted green laser in Bhabtron II while it was wall mounted red laser in planning room supplied with Philips Planning CT machine.

The comfort of the healthcare personnel were taken in Likert scale of 0 to 10 where 0 is the most unsatisfactory while 10 is the one with best visibility. We also asked the subjects for their comfort level on the same Likert scale.

1	10	19	28
2	2 11	20	29
3	12	21	30
4	13	22	31
5	14	23	32
6	15	24	33
7	16	25	34
8	17	26	35
9	18	27	36

Fig. 4: Felix von Luschanskincolorchart

RESULTS

There were 82 analyzable subjects with 41 in each arm and there were no incidence of hyper-sensitivity to mehendi during the procedure. Out of these patients, from the site of primary carcinoma cervix, breast, rectum, head and neck, sarcomas were included. They were fairly evenly distributed between the arms (table 1).

Thus, a large percentage of patients (52.4%) were treated at pelvis where maintain hygiene during radiotherapy is utmost important and difficult without bath. Independent sample T test was done which showed that there was no difference of total duration of radiotherapy planned between the two arms. (p=0.371). Thus, the intervention and control group had been adequately randomized.

The number of applications for test (mehndi) arm ranged from 2 to 3, with majority (32 out of 41 being 2). The same for the control arm ranged from 2 to 6, with one patient requiring 2 applications and one requiring 5 and 6 applications.

The mean duration of application for the test arm was 11.11 days compared to 7.5 days in control arm. The mean duration for 1^{st} reapplication was 8.4 days in test arm compared to 6.8 in control arm. The mean duration for 2^{nd} reapplication was 13.1 days in test arm compared to 7.8 days in control arm.

Independent sample T test and Mann-Whitney U test were significant across number of applications, average duration of application, Duration between reapplication 1, 2 and 3. Since there was only one reapplication for 4th and 5th time, statistical tests for the same could not be performed.

Table 1: Distribution of site of irradiation according to a	ırm
---	-----

		Diagnosis					
		Cervix	Rectum	Breast	Sarcoma	H&N	Others
		Count	Count	Count	Count	Count	Count
arm	pen	12	9	12	3	5	0
	mehndi	16	6	12	2	5	0

Table 2: Comparison between pen and mehndi arm

Arm	Mehndi	Pen
Median number of applications (range)	2 (2-3)	4 (2-6)
Mean duration (days)	11.11	7.4
Median (days)	11.5	7.25
Range (days)	9-14.5	5.5-10
Median duration of 1 st application (days)	8	7
Median duration of 2 nd application (days)	14	8
Patients requiring 3 rd application	9 (22%)	40(98%)
Median duration of 3 rd application (days)	14	8
Patients requiring 4 th application	0 (0%)	24(59%)
Median duration of 4 th application (days)	Not applicable	7
Patients requiring 5 th application	0 (0%)	1(0.5%)
Median duration of 5 th application (days)	Not applicable	7.5

 Table 3: Test of Significance: Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1.	The distribution of reapp 1 is the same across	Independent-Samples	0.000	Reject the null
	categories of arm	Mann-Whitney U Test		hypothesis
2.	The distribution of reapp 2 is the same across	Independent-Samples	0.000	Reject the null
	categories of arm	Mann-Whitney U Test		hypothesis
3.	The distribution of reapp 3 is the same across	Independent-Samples	0.000*	Reject the null
	categories of arm	Mann-Whitney U Test		hypothesis
4.	The distribution of reapp 4 is the same across	Independent-Samples		Unable to compute
	categories of arm	Mann-Whitney U Test		
5.	The distribution of total number of application	Independent-Samples	0.000	Reject the null
	required is the same across categories of arm	Mann-Whitney U Test		hypothesis
6.	The distribution of average duration of each	Independent-Samples	0.000	Reject the null
	application is the same across categories of arm	Mann-Whitney U Test		hypothesis

Reapp 1- time for 1st reapplication in days; Reapp 2- time between 1st and 2nd reapplication in days; Reapp 3-time between 2nd and 3rd reapplication in days; Reapp 4- time between 3rd and 4th reapplication in days. Asymptotic significance are displayed. The significance level is 0.05. *Exact significance is displayed for this test.

DISCUSSION

Mehndi had been used as temporary ceremonial skin marking in Indian subcontinent for ages. Mehndi is the paste made from Henna, which is the dried leaf of Lawsonia inermis.(2) Mehndi has lawsone (2hydroxy-1, 4-naphthoquinone) a pigment which gets absorbed in the outer porous layer of skin and binds to the keratin thus creating a durable stain.(3) Henna leaf extracts have been shown to have antimicrobial property against common bacterial skin infections (4, 5) as well as against candida albicans (6). However some people are allergic to mehndi especially in form "black henna" which contains of para-Phenylenediamine (PPD) which may cause contact dermatitis (7).

Henna or Mehndi has been used for temporary markings in surgery by various authors.(8, 9) In Conventional radiotherapy, where thermoplastic ray casts or alfa cradle are not used the only way for setting up of patient is to use skin markings. In such conventional planning temporary markings have been used extensively and have been found to be equivalent to permanent small tattoos.(10) Permanent tattoos are more suitable for advanced radiotherapeutic techniques like IGRT, IMRT where three point localization is absolute and enough (11).

In our study we compared the conventionally used pen markings with that of the mehndi. The number of applications required were significantly less (Mean number of applications were 2.2 in Mehndi arm compared to 3.63 in Control arm, median being 2 and 4 respectively, P=.000), the duration of stability of each application were more from the first application itself in mehndi arm compared to test arm. These differences were statistically significant (Table2). The median durability when calculated across all applications was 11.5 days (range 9 to 14.5 days) with mehndi compared to 7.25 days with pen (range 5.5 to 10 days). In the study by Wurstbeuar *et al.*, the median duration of henna application was 23 days (range 12-48 days) with number of required applications being 1 to 4.(12) In the study by Tunio

and Hasmi, the mean duration was 10 to 28 days (mean 18 days).(13) In our study the required number of applications was 2-3 for mehndi arm and 2 to 6 in the control arm (Table 2). Moreover, the stability of mehndi increased over repeated number of applications while that remained static in case of pen marking. Only 7,however except in cases of breast patients, in both the studies only the isocenters were marked, while we had marked the whole field borders defined by light fields. This may have contributed to reduction of durability of the markings, since repeat marking was done even if a part of the same had become difficult to visualize.

There was no difference in the visibility as reported by healthcare personnels in ambient lighting, as well as under laser both green and red when compared with matched skin tones. However, penmarking was relatively difficult to visualise under green laser in cases of skin tones 29 and above in Felix vonLuschan skin colour chart. Under red laser both were equally visible.

The consultants were more comfortable with mehndi markings, along with the Machine room technologists. However, the residents were more comfortable with Pen markings as documented in the likert scale. The duration of the process was listed as reason for them being not comfortable with the process. The turnover simulator time was however same and there was no change in number of patients simulated whether they were marked with Mehndi or pen as we used a second room for stabilization of Mehndi. This duration (60 min) was kept much higher in our a study than in study by Wurstbauer (10 min) as they had used only point marking while we had used marking of the entire border of the light field (12).

Patient satisfaction scores were better in the mehndi arm. They could take bath without scrubbing at will.

CONCLUSION

The present study is the first known study on Indian patients which compared pen marking and mehendi in a randomized manner. The study shows that Mehndi not only is more durable than the pen marking it is equally visible for HCPs and more comfortable to patients. The skin tone of our patients did not pose any challenge in visualization during set up either in ambient lighting or with lasers. The time required for the procedure is lengthy but is worthy for the time.

CONFLICT OF INTEREST

Authors declare no conflicts of interest.

REFERENCES

 Treesirichod, A., Chansakulporn, S., Wattanapan, P. Correlation between skin color evaluation by skin color scale chart and narrowband reflectance spectrophotometer. Indian J Dermatol. 2014; 59(4): 339-342.

- Singh, M., Jindal, S., Kavia, Z., Jangid, B., Khem, C. Traditional methods of cultivation and processing of henna. Henna, cultivation, improvement and trade. 2005: 21-34.
- Behera, C., Swain, R., Bhardwaj, D. N., Millo, T. Skin suicide note written in mehndi (henna). Med Leg J. 2016; 84(1): 39-41.
- Al-Rubiay, K. K., Jaber, N. N., Al Mhaawe, B. H., Alrubaiy, L. K., Antimicrobial efficacy of henna extracts. Oman Med J. 2008; 23(4): 253-256.
- Habbal, O., Hasson, S. S., El-Hag, A. H., Al-Mahrooqi, Z., Al-Hashmi, N., Al-Bimani, Z., *et al.*, Antibacterial activity of *Lawsonia inermis* Linn (Henna) against *Pseudomonas aeruginosa*. Asian Pac J Trop Biomed. 2011; 1(3): 173-176.
- Nawasrah, A., AlNimr, A., Ali, A. A. Antifungal effect of Henna against *Candida albicans* adhered to acrylic resin as a possible method for prevention of denture stomatitis. Int J Environ Res Public Health. 2016; 13(5).
- Sinha, A., Goel, L., Ranjan, R., Gaba, S., Kumar, A. Atraumatic acute compartment syndrome of forearm following artificial mehndi (henna) dermatitis - a rare case report. J Clin Diagn Res. 2017; 11(6): RD01-RD03.
- Mehendale, V. G., Chaudhari, N. C., Shenoy, S. N., Mehendale, A. V. Henna as a durable preoperative skin marker. World J Surg. 2011; 35(2): 311-315.
- Ankit, T., Nihsit, B., Anurag, T., Purushotham, L., Nitish, R. Use of henna as a durable pre-operative skin marker for accurate localisation of vertebral level in spine surgery. International Journal of Research in Orthopedics. 2017; 3(3): 461-465.
- Probst, H., Dodwell, D., Gray, J. C., Holmes, M. An evaluation of the accuracy of semi-permanent skin marks for breast cancer irradiation. Radiography. 2006; 12(3): 186-188.
- 11. Rathod, S., Munshi, A., Agarwal, J. Skin markings methods and guidelines: A reality in image guidance radiotherapy era. South Asian J Cancer. 2012; 1(1): 27-29.
- Wurstbauer, K., Sedlmayer, F., Kogelnik, H. D. Skin markings in external radiotherapy by temporary tattooing with henna: improvement of accuracy and increased patient comfort. Int J Radiat Oncol Biol Phys. 2001; 50(1): 179-181.
- Tunio, M. A. Rafi, M., Hashmi, A. Comparison of Three methods for skin tattooing in conformal radiotherapy, temporary (markers, henna) and permanent Steritatt CIVCO®: Patients and radiographers comfort. The South African Radiographer. 2009; 47(2).