doi:10.36849/JDD.2020.4647

Long-Term Efficacy and Safety of Superficial Radiation Therapy in Subjects With Nonmelanoma Skin Cancer: A Retrospective Registry Study

William Roth MD,[a] Robert E. Beer MD,[b] Vivek Iyengar MD,[c] Thomas Bender MD,[d] Isabelle Raymond PhD[e]

[a]Dermatology and Dermatological Surgery, Boynton Beach, FL
[b]Balfour Dermatology, Brentwood, CA
[c]Dermatology Associates, Tinley Park, IL
[d]Advanced Dermatology and Skin Care Centre, Mobile, AL
[e]Sensus Healthcare, Boca Raton, FL

ABSTRACT

Background: Low-dose superficial radiation therapy (SRT) effectively treats nonmelanoma skin cancer (NMSC) without requiring invasive excision. SRT is especially safe and effective among the elderly who comprise most patients with basal cell and squamous cell carcinomas (BCCs and SCCs).

Objective: To demonstrate the long-term safety and efficacy of SRT for treating NMSC with a new generation device.

Methods: A retrospective chart review was performed at four clinical study sites. The study population included male and female patients (N=516) treated with SRT for NMSC (N=776) including BCCs (n=448) and SCCs (n=328) prior to January 2015 with long-term follow-up records.

Results: The overall mean (SD) total treatment dosage was 4652.33 (366.34) cGy (range, 3636.6 to 5455 cGy) administered over a mean of 12.3 (1.85) sessions. The overall Kaplan-Meier survival probability estimate (95% CI) was 0.989 (0.980, 0.998) at 24 months, 0.989 (0.969, 1.000) at 60 months, and 0.989 (0.942, 1.000) at 85 months. There were six recurrences of BCCs (n=4) and SCCs (n=2). The most common adverse event was hypopigmentation.

Limitations: Retrospective study design and some incomplete data.

Conclusion: It is estimated that 98.9% of nonmelanoma skin cancers will not recur after 85 months following superficial radiation therapy.

J Drugs Dermatol. 2020;19(2)163-168. doi:10.36849/JDD.2020.4647

INTRODUCTION

Nonmelanoma skin cancer (NMSC) comprises basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and numerous less common skin tumors.[1] NMSCs are the commonest form of malignancy among Caucasians[2] and its incidence continues to rise worldwide.[3] Although Mohs surgery has traditionally been regarded as the gold-standard for treating NMSC,[4] it may not be suitable for the elderly due to frailty, limited life-expectancy, and comorbidities.[5-7]

Superficial radiation therapy (SRT) comprises low energy X-rays produced by units generally operating in the 50 to 150 kV range. SRT was the standard of care for office-based radiation treatment of NMSCs for more than 100 years but declined during the 1980s due to an increase in the popularity of Mohs micrographic surgery and because there were no new devices to replace older ones;[8] however, the use of SRT is currently seeing a resurgence following the reintroduction of newer, easy-to-use SRT equipment.[9] Low-dose SRT effectively treats NMSC without requiring invasive excision.[10] SRT can be performed as an office procedure without anesthesia,[11] minimal risk of infection and superior cosmetic outcomes.[12] Recovery is rapid with no or minimal downtime or lifestyle restrictions. SRT has been shown to be safe and very effective among elderly who comprise the majority of patients with NMSC.[8,13]

The objective of this retrospective chart review was to further demonstrate the long-term efficacy of SRT for treating NMSCs with a new generation device.

METHODS

Seven clinical centers across the US that treated NMSCs with SRT for at least 5 years were contacted to participate. Sites were required to have treated at least 50 patients with ≥5-year follow-up. Three sites declined or did not respond. The study was therefore conducted in four clinical practices, where three of the four investigators were also Mohs surgeons. Retrospective chart reviews identified 516 subjects treated for 776 histologically confirmed, primary, cutaneous NMSC lesions. Relevant clinical

information regarding patient demographics, tumor characteristics, treatment parameters, and adverse events was recorded along with evidence of latent adverse events and lesion recurrence at follow-up. One site excluded data from patients treated for lower legs that were reported in another publication.[13] Initial and recurrent lesions were staged according to the American Joint Committee on Cancer staging system for NMSCs.[14]

Study Population

The study population included male and female patients treated with SRT for NMSC prior to January 2015; had one or more lesions treated with a minimum 5 mm space between lesion margins; and for whom the required long-term retrospective data was available. All subjects were treated with the same device (SRT-100™, Sensus Healthcare, Boca Raton, FL).

Statistical Analysis

Because of the variation in follow-up duration among patients, Kaplan-Meier survival probability estimates were used to determine the recurrence rates for all tumors. Kaplan-Meier estimates were calculated across available follow-up data and reported as recurrence probability and 95% confidence intervals by follow-up year.

Ethics

The study protocol was determined to meet the conditions for exemption under 45 CFR 46.101(b)(4) by a commercial IRB (Western Institutional Review Board (WIRB), Puyallup, WA). ClinicalTrials.gov Identifier: NCT03693937.

RESULTS

Demographics and Clinical Characteristics

The 516 subjects included in the analysis were treated for 776 NMSCs. Subjects were male (n=293; 57%) and female (n=223; 43%) with a mean (SD) age of 79 (8.7) years (range, 42 to 100 years). Most were 60 to 79 years old (46%) years and 80 to 89 years old (43%). Among subjects for whom race was recorded (n=283; 55%), all were Caucasian. Most subjects (n=366; 71%) were treated for single lesions and the remainder were treated for multiple lesions. Comorbid illnesses were recorded for 173 subjects (33.5%), many of whom had multiple comorbidities (Table 1).

Among the 776 lesions, 448 (58%) were diagnosed as BCCs and 328 (42%) were diagnosed as SCCs. Subtype diagnosis was reported for 330 of the 448 BCC lesions (74%), and for 186 of the 328 SCC lesions (57%). The predominant BCC subtypes were nodular (49%), infiltrative (16%), superficial (11%), and infiltrative + superficial (11%). The predominant SCC subtypes were in situ/Bowen's disease (42%), well-differentiated (20%), and keratoacanthoma (10%). All but ten lesions were new. Recurrent BCCs (n=7) were previously treated with electrosurgery (n=2) and excision (n=1). Recurrent SCCs (n=3) were previously treated with curettage and electrodesiccation.

TABLE 1.

Comorbidities of Subjects Treated with SRT	
	n
Significant Cardiovascular Disease	54
Diabetes	44
Anticoagulation Therapy	36
Immunosuppressed	22
Congestive Heart Failure	21
Leg Edema	16
Chronic Obstructive Pulmonary Disease	15
History of MRSA	11
Dementia	10
Hypertension	10
Cancer/Non-Hodgkin's Lymphoma	6
Peripheral Vascular Disease	5
Coronary Bypass Surgery	4
Stasis Dermatitis	4
Bleeding Disorder	3
Kidney Dialysis	3
History of Stroke	2
Lupus	1
Polymyalgia	1
Staphylococcal Infection in Treatment Area	1

TABLE 2.

Lesion Location			
Location, n (%)	All (n=776)	BCC (n=448)	SCC (n=328)
Nose	179 (23)	151 (34)	28 (8)
Lower leg	118 (15)	44 (10)	74 (23)
Forehead	76 (10)	44 (10)	32 (10)
Ear	71 (9)	49 (11)	22 (7)
Cheek	65 (8)	41 (9)	24 (7)
Scalp	51 (7)	14 (3)	37 (11)
Lower arm	49 (6)	9 (2)	40 (12)
Body Trunk	36 (5)	24 (5)	12 (3)
Hand	25 (3)	1 (<1)	24 (7)
Neck	24 (3)	17 (4)	7 (2)
Upper arm	22 (3)	9 (2)	13 (4)
Chin	17 (2)	12 (3)	5 (2)
Lips	15 (2)	12 (3)	3 (1)
Temple	7 (1)	7 (2)	--
Foot	6 (1)	4 (<1)	2 (1)
Upper leg	5 (1)	3 (<1)	2 (1)
Eyelid	5 (1)	5 (1)	--
Chest	4 (<1)	2 (<1)	2 (1)
Face	1 (<1)	--	1 (<1)

TABLE 3.

Follow-up Duration			
Months	All NMSCs, n (%)	BCC, n (%)	SCC, n (%)
<6	71 (9)	43 (10)	28 (9)
6 – 12	96 (13)	59 (13)	37 (11.5)
13 – 23	77 (10)	40 (9)	37 (11.5)
24 – 35	90 (12)	55 (13)	35 (11)
36 – 47	130 (17)	60 (14)	70 (22)
48 – 59	176 (23)	110 (25)	66 (20)
≥60	118 (16)	70 (16)	48 (15)

The mean (SD) lesion size was reported for 763 NMSCs (98%). Across all NMSC lesions, mean lesion size was 1.56 cm (1.1) (range, 0.3 to 6.5 cm), with 538 lesions (70.5%) <2 cm and 225 (29.5%) ≥2 cm. Most lesions were located on the head and neck. The distribution and frequency of lesion locations is summarized in Table 2.

Superficial Radiation Therapy Variables

Treatment variables were available for 763 lesions for which the full SRT treatment protocol was completed. Incomplete treatments were primarily due to patient non-compliance or unrelated patient death prior to treatment completion. For one lesion, treatment was prematurely stopped due to severe pain at the treatment site. As a result of early SRT termination, eight lesions did not attain complete cure immediately following treatment completion. Follow-up was limited-to-none for these lesions and they were excluded from the treatment analyses.

Lesions (n=763) were treated with a mean total dose of 4652.33 (366.34) cGy (range, 3636.6 to 5455 cGy) over a mean of 12.3 (1.85) SRT fractions (range, 6 to 18). Across all treated NMSCs, the most frequent number of total SRT fractions was 12, occurring for about one-half of all lesions. Fractions were administered three times weekly for most lesions (84%) over a mean of (29.2) days (range, 10 to 60 days).

The mean time dose fractionation (TDF) factor for all lesions was 99.11 (2.29; range, 87.5-116). The low TDF factor of 87.5 was due to one subject completing only 11 of 12 planned treatments. One BCC lesion with an outlier TDF of 130 was excluded from the analysis but it is worth noting this patient was treated for a small infiltrative BCC. The higher TDF reflects a prior standard of practice together with the infiltrative quality and white appearance of the lesion and the physicians' belief that this high dose was appropriate for a lesion that clinically had some features of a sclerosing basal cell carcinoma. There was some initial bleeding and mild hypopigmentation following treatment, but the overall outcome was positive.

The mean treatment margins for BCC lesions (n=433) was 6.8 (2.6) mm (range, 1.5 to 23.5 mm). The 23.5 mm margin was an outlier. The mean treatment margin for SCC lesions (n=308) was 7.9 (2.8) mm (range, 2.5 to 12 mm). The margins were kept the same throughout the course of treatment.

Energy was recorded for nearly all treated NMSCs (n=759). A treatment energy of 50 KV was applied to most lesions (91%) across both subtypes. Fewer lesions were treated with 70 (8%) or 100 KV (1%). For two BCC and two SCC lesions, the treatment energy was recorded as both 50 and 70 KV and were not included in the summary. Overall, 694 (91%) lesions received SRT fractions without interruption during the entire course of treatment while 79 lesions (29 BCC; 40 SCC) required treatment breaks. The mean duration of these breaks was 16.2 days and most frequent duration was 14 days (38%) and 21 days (17%).

Immediate Efficacy

The overall cure rate was defined as the percentage of NMSC lesions attaining complete cure immediately following the course of SRT treatment. Complete cure data was available for 760 treated lesions (98%).

Nine of the 760 NMSC lesions (5 SCC and 4 BCC), occurring in six patients, with two patients having two lesions each, did not demonstrate complete cure; however, only one of these nine lesions received the full SRT treatment. Incomplete treatments were due to patient non-compliance (n=4), or reasons unrelated to NMSC or SRT (n=4). The individual with the one fully treated lesion was sent to oculoplastic surgeon (due to lesion location) for follow-up, and the final outcome for the lesion is unknown. When the cure rate was calculated regardless of whether the full treatment protocol was completed, the overall cure rate was 98.82% for all lesions (N=760).

Treatment Follow-up

The most recent follow-up visit since the last SRT was recorded for 768 NMSCs (99%); however, no evaluation was reported for ten lesions resulting final evaluable set of 758 NMSCs (437 BCCs and 321 SCCs). The distribution of follow-up duration for all lesions is summarized in Table 3. Overall, the mean post-treatment follow-up was 36.5 (21.6) months (range, 1 to 85 months).

Recurrence

There were six recurrences among the 759 treated lesions for which the presence or absence of a recurrence was reported, of which one was inconclusive. That lesion had a 3x3 mm crusted plaque at the site that made determination of recurrence uncertain. If all six lesions were included, the long-term cure rate was 99.21% (recurrence rate 0.79%). If the questionable recurrence is removed from the calculation, the long-term cure rate was 99.34% (recurrence rate 0.66%).

Data regarding recurrent lesions is summarized in Table 4. Lesions recurred after a mean of 13.3 months (range, 3 to 24

TABLE 4.

Patient Demographics and Clinical Characteristics of Recurring Lesions

Subject	Gender	Age (yrs)	Diagnosis Subtype	Location	Size (cm)	New or Recurring	Recurrence (months)	Last Follow-up (months)	Immediate Adverse Events	Latent Adverse Events
1	male	87	BCC, infiltrative	eyelid	0.3	new	9	9	redness, scaling: 3x3 mm crusted plaque on lesion	none
2	female	94	BCC	nose	2.5	recurring	9	18	redness; moist; ulcerated	none
3	male	80	BCC, infiltrative	right cheek	2.8	new	11	45	inflammation; ulceration	hypopigmentation which later worsened; atrophy
4	male	87	SCC, well-differentiated, KA Type	right lower leg	2.2	new	3	59	inflammation; crusting	hypopigmentation
5	male	84	SCC, well-differentiated, KA Type	lower leg	1.3	new	24	58	inflammation; crusting	hypopigmentation
6	male	84	BCC, infiltrative	nose	0.5	new	24	65	inflammation; crusting	hypopigmentation

Subject 1. Recurrence inconclusive. Patient sent for follow-up with oculoplastic surgeon.
Subject 2. Recurrent lesions previously treated with excision demonstrated complete cure following SRT treatment completion but recurred 9 months later. Treated with Mohs surgery. Outcome unknown as patient has since deceased.
Subject 3. Lesion not involved in hypopigmented area but close enough and of same pathology to be considered a recurrence. Patient immunosuppressed and on renal dialysis with extensive skin cancers over the face, trunk and extremities. Recurrence treated with electrosurgery.
Subject 4. Biopsy showed SCC KA-type lesion. It was noted that keratoacanthomas can occur in traumatized areas and are not unusual after excisions. As it was unclear if this was a recurrence or stimulation of new growth, it was conservatively considered a recurrence. The lesion was retreated with electrosurgery.
Subject 5. Patient had extensive skin cancers on the legs. This lesion occurred 2 years post-SRT on the edge of the radiated area and was therefore considered a recurrence. The lesion was treated with Mohs surgery
Subject 6. The recurrent lesion was very extensive although the skin appeared normal microscopically. It was believed that the recurrence was due to inadequate treatment margins. The lesion was treated with Mohs surgery.

months). AEs and latent AEs were reported for each recurrent lesion; however, none were noted as serious. Recurrent lesions were subsequently treated with Mohs surgery (n=3), electrosurgery (n=2), or lost to follow-up (n=1).

Kaplan-Meier Probability Estimates of Lesion Recurrence

The overall Kaplan-Meier survival probability estimate (95% CI) was 0.989 (0.980, 0.998) at 24 months, 0.989 (0.969, 1.000) at 60 months, and 0.989 (0.942, 1.000) at 85 months (Table 5). Survival probability for BCCs were 0.988 (0.975, 1.000) at 24 months, 0.988 (0.960, 1.000) at 60 months, and 0.988 (0.930, 1.000) at 85 months (Table 5). The survival probability estimates for SCCs were 0.991 (0.979, 1.000) at 24 months, 0.991 (0.962, 1.000) at 60 months, and 0.991 (0.910, 1.000) at 85 months (Table 5).

Survival probability estimates (95% CI) were also calculated based on lesion size. For lesions <2 cm in diameter, the survival probability was 0.982 (0.982, 1.00) at 24 months, 0.982 (0.971, 1.000) at 60 months, and 0.982 (0.945, 1.00) at 85 months. For lesions ≥2 cm, the survival probability was 0.983 (0.963, 1.000) at 24 months, 0.983 (0.930, 1.000) at 60 months, and 0.983 (0.803, 1.00) at 85 months. Although a limited number of recurrences were noted, a multivariate Cox regression analysis was conducted to assess the potential influence of gender, age, NMSC type, lesion size, and treatment margin, which failed to demonstrate any significant association with recurrence-free survival.

Safety

One of the four participating study sites (n=130 subjects) did not note any immediate or latent adverse events (AEs) in the medical charts. One site (n=350 subjects) noted radiation dermatitis for six treated lesions from two subjects.

A third study site noted AEs for all treated lesions (n=74) consisting of redness alone or in combination with one or more events of scaly, itchy, hot, and moist. Other noted AEs included ulcer-

TABLE 5.

Kaplan-Meier Survival Probability Estimates			
All Nonmelanoma Skin Cancers			
Month	Survival Probability Estimate	95% Confidence Interval Limit	
		Lower	Upper
12	0.993	0.987	0.999
24	0.989	0.980	0.998
36	0.989	0.979	0.999
48	0.989	0.977	1.000
60	0.989	0.969	1.000
72	0.989	0.943	1.000
85	0.989	0.942	1.000
Basal Cell Carcinoma Lesions			
Month	Survival Probability Estimate	95% Confidence Interval Limit	
		Lower	Upper
12	0.991	0.981	1.000
24	0.988	0.975	1.000
36	0.988	0.974	1.000
48	0.988	0.971	1.000
60	0.988	0.960	1.000
72	0.988	0.930	1.000
85	0.988	0.930	1.000
Squamous Cell Carcinoma Lesions			
Month	Survival Probability Estimate	95% Confidence Interval Limit	
		Lower	Upper
12	0.999	0.988	1.000
24	0.991	0.979	1.000
36	0.991	0.978	1.000
48	0.991	0.974	1.000
60	0.991	0.962	1.000
72	0.991	0.911	1.000
85	0.991	0.910	1.000

ation (n=6; 8%) and latent AEs included burning, itching, pain (n=5), hyperpigmentation (n=2), scarring (n=2), and radiogenic ulceration (n=1).

The fourth study site noted AEs for all NMSC lesions treated at the site (n=225) consisting of inflammation alone or together with crusted and ulcerated skin. Other AEs included one instance of each of the following: mucositis, hypopigmentation, and hair loss. Latent AEs included hypopigmentation (n=173; 77%), atrophy (n=10), acute pain (n=2), *Staphylococcal* infection requiring antibiotics (n=1), mucositis (n=1), epistaxis (n=1), and minor hair loss (n=1).

DISCUSSION

Superficial radiation therapy has been used to treat NMSC for over a century with low recurrence rates and favorable cosmesis.[10] The objective of this study was to further demonstrate the long-term efficacy of SRT for treating NMSCs with a new generation device. The results of this present study revealed overall cure rates of 98.9% at 24, 60, and 85 months. This compares favorably with the cure rates of 98.1% at 24 months and 95.0% at 60 months[10] and 97.4% after 36 months[13] reported by others.

Higher cure rates in the present study could be partly due to more optimal treatment parameters including a higher number of doses (fractions) and/or dosing frequency. Recent consensus guidelines[15] suggest treatment recommendations should be speci¬fic for anatomical locations and that changes in SRT fractionation schemes by increased number and time between treatments have led to better outcomes.[16-18] The treatment margins were also kept consistent throughout the duration of the treatment and TDF was kept between 90 and 110, which is within the suggested therapeutic window.[19] Another reason cure rates may have been higher is patient selection. As three of the four study investigators were Mohs surgeons, it is possible they selected patients who were more ideally suited for SRT versus patients better suited for Mohs surgery.

Other possible reasons for higher cure rates includes site selection, which was biased toward sites with long-term data and the availability of staff to collect patient information. The retrospective nature of the study also increased the possibility that some lesion recurrences were lost to follow-up. Still, there were six recurrences that were noted at follow up. One lesion was recurrent prior to SRT, which made it a higher risk of recurring,[20] but other lesions were not. It is difficult to say why some lesions recurred and regression analysis failed to demonstrate any significant associations. Importantly, recurring lesions were all subsequently treated successfully with other modalities.

AEs were inconsistently noted in medical charts and varied between sites. We suspect some site recorded all AEs and others only recorded unexpected AEs. Expected AEs with SRT include transient redness and scaliness at the treatment site. More significant AEs and latent AEs responded to treatment and eventually resolved.

Superficial radiation therapy is currently recommended as an alternative to surgery for primary BCCs and SCCs of the head and neck,[21] particularly when surgery may result in functional deficits or poor cosmetic outcomes.[7,15,22] The National Comprehensive Cancer Network® Guidelines recommend radiotherapy for patients with BCC and SCC who are not candidates for surgery, or over 60 years of age because of concerns about long-term sequelae;[23,24] however, radiation therapy is contraindicated in

genetic conditions predisposing to skin cancer (basal cell nevus syndrome, xeroderma pigmentosum) and connective tissue diseases (scleroderma).[23,24] Recent consensus guidelines suggest SRT should be used as first-line therapy for treating appropriate types of NMSC tumors, such as primary BCC, SCC, significant SCC in situ,[15] which were made up the majority of the lesions in the current study. These results would support this statement and highlight that cure rates can be as effective as surgery for appropriate lesion and patient. Furthermore, SRT has been shown to be a viable treatment option in frail, elderly patients[13] who represent a large proportion of patients with NMSCs. SRT may be preferable to surgery in this population due to comorbidities and limited life expectancy.[25,26]

CONCLUSION

Superficial radiation therapy is an effective and well-tolerated treatment for nonmelanoma skin cancers. These results add to the existing evidence demonstrating the safety and long-term efficacy of SRT for treating NMSC.

DISCLOSURES

Dr. Raymond is a full-time Sensus Healthcare employee who receives a salary and own stock in the company. Drs. Roth, Iyengar, Bender, and Beer received honoraria from Sensus Healthcare for their participation in this study.

ACKNOWLEDGMENT

This study was sponsored by Sensus Healthcare, Boca Raton, FL. The authors acknowledge the editorial assistance of Dr. Carl S. Hornfeldt, Apothekon, Inc., and statistical analyses by Elvira Cawthon, Regulatory Insight during the preparation of this manuscript. Dr. Raymond is a full-time Sensus Healthcare employee who receives a salary and own stock in the company. Drs. Roth, Iyengar, Bender, and Beer received honoraria from Sensus Healthcare for their participation in this study.

REFERENCES

1. Griffin LL, Ali FR, Lear JT. Non-melanoma skin cancer. *Clin Med (Lond).* 2016;16:62-65.
2. Apalla Z, Lallas A, Sotiriou E, Lazaridou E, Ioannides D. Epidemiological trends in skin cancers. *Dermatol Pract Concept.* 2017;7:1-6.
3. Leiter U, Keim U, Eigentler T, Katalinic A H, olleczek B, Martus P, Garbe C. Incidence, mortality, and trends of nonmelanoma skin cancer in Germany. *J Invest Dermatol.* 2017;137:1860-1867.
4. Gualdi G, Monari P, Apalla Z, Lallas A. Surgical treatment of basal cell carcinoma and squamous cell carcinoma. *G Ital Dermatol Venereol.* 2015;150:435-447.
5. Garcovich S, Colloca G, Sollena P, Andrea B, Balducci L, Cho WC, Bernabei R, Peris K. Skin cancer epidemics in the elderly as an emerging issue in geriatric oncology. *Aging Dis.* 2017;8:643-661.
6. Čeović R, Petković M, Mokos ZB, Kostović K. Nonsurgical treatment of nonmelanoma skin cancer in the mature patient. *Clin Dermatol.* 2018;36:177-187.
7. Newlands C, Currie R, Memon A, Whitaker S, Woolford T. Non-melanoma skin cancer: United Kingdom National Multidisciplinary Guidelines. *J Laryngol Otol.* 2016;130:S125-132.
8. Cognetta AB Jr, Wolfe CM, Goldberg DJ, Hong HG. Practice and educational gaps in radiation therapy in dermatology. *Dermatol Clin.* 2016;34:319-333.
9. SRT-100™. Sensus Healthcare, Boca Raton, FL. Available: https://www.sensushealthcare.com/superficial-radiation-therapy/srt-100/. Accessed 04-29-19.
10. Cognetta AB, Howard BM, Heaton HP, Stoddard ER, Hong HG, Green WH. Superficial x-ray in the treatment of basal and squamous cell carcinomas: a viable option in select patients. *J Am Acad Dermatol.* 2012;67:1235-1241.
11. McGregor S, Minni J, Herold D. Superficial radiation therapy for the treatment of nonmelanoma skin cancers. *J Clin Aesthet Dermatol.* 2015;8:12-14.
12. Piccinno R, Tavecchio S, Benzecry V. Superficial radiotherapy for non-melanoma skin cancer of the lip: a 44-year Italian experience. *J Dermatolog Treat.* 2019;11:1-17.
13. Roth WI, Shelling M, Fishman K. Superficial radiation therapy: a viable nonsurgical option for treating basal and squamous cell carcinoma of the lower extremities. *J Drugs Dermatol.* 2019;18:130-134.
14. Farasat S, Yu SS, Neel VA, Nehal KS, Lardaro T, Mihm MC, Byrd DR, Balch CM, Califano JA, Chuang AY, Sharfman WH, Shah JP, Nghiem P, Otley CC, Tufaro AP, Johnson TM, Sober AJ, Liégeois NJ. A new American Joint Committee on Cancer staging system for cutaneous squamous cell carcinoma: creation and rationale for inclusion of tumor (T) characteristics. *J Am Acad Dermatol.* 2011;64:1051-1059.
15. Nestor MS, Berman B, Goldberg D, Cognetta AB Jr, Gold M, Roth W, Cockerell CJ, Glick B. Consensus guidelines on the use of superficial radiation therapy for treating nonmelanoma skin cancers and keloids. *J Clin Aesthet Dermatol.* 2019;12:12-18.
16. Fitzpatrick PJ, Thompson GA, Easterbrook WM, Gallie BL, Payne DG. Basal and squamous cell carcinoma of the eyelids and their treatment by radiotherapy. *Int J Radiat Oncol Biol Phys.* 1984;10:449-454.
17. Tsao MN, Tsang RW, Liu FF, Panzarella T, Rotstein L. Radiotherapy management for squamous cell carcinoma of the nasal skin: the Princess Margaret Hospital experience. *Int J Radiat Oncol Biol Phys.* 2002;52:973-979.
18. Zaorsky NG, Lee CT, Zhang E, Keith SW, Galloway TJ. Hypofractionated radiation therapy for basal and squamous cell skin cancer: a meta-analysis. *Radiother Oncol.* 2017;125:13-20.
19. Orton CG, Ellis F. A simplification in the use of the NSD concept in practical radiotherapy. *Br J Radiol.* 1973;46:529-537.
20. Gillard M, Wang TS, Johnson TM. Nonmelanoma Cutaneous Malignancies. In: Chang AE GP, Hayes DF, Kinsella T, Pass HI, Schiller JH, Stone RM, Strecher V, , ed. *Oncology: An Evidence-Based Approach.* Berlin/Heidelberg, Germany: Springer Science & Business Media; 2007.
21. Grossi Marconi D, da Costa Resende B, Rauber E, de Cassia Soares P, Fernandes JM Jr, Mehta N, Lopes Carvalho A, Kupelian PA, Chen A. Head and neck non-melanoma skin cancer treated by superficial X-ray therapy: an analysis of 1021 cases. *PLoS One.* 2016;11:e0156544.
22. Mendenhall WM, Amdur RJ, Hinerman RW, Cognetta AB, Mendenhall NP. Radiotherapy for cutaneous squamous and basal cell carcinomas of the head and neck. *Laryngoscope.* 2009;119:1994-1999.
23. Bichakjian CK, Olencki T, Aasi SZ, Alam M, Andersen JS, Berg D, Bowen GM, Cheney RT, Daniels GA, Glass LF, Grekin RC, Grossman K, Higgins SA, Ho AL, Lewis KD, Lydiatt DD, Nehal KS, Nghiem P, Olsen EA, Schmults CD, Sekulic A, Shaha AR, Thorstad WL, Tuli M, Urist MM, Wang TS, Wong SL, Zic JA, Hoffmann KG, Engh A. Basal cell skin cancer, Version 1.2016, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw.* 2016;14:574-597.
24. Bichakjian CK, Olencki T, Aasi SZ, al e. Squamous cell skin cancer, Version 2.2018, NCCN Clinical Practice Guidelines in Oncology. October 5, 2017. Available: https://www.nccn.org/professionals/physician_gls/recently_updated.aspx. Accessed 04-19-19.
25. Linos E, Parvataneni R, Stuart SE, Boscardin WJ, Landefeld CS, Chren MM. Treatment of nonfatal conditions at the end of life: nonmelanoma skin cancer. *JAMA Intern Med.* 2013;173:1006-1012.
26. Linos E, Chren MM, Stijacic Cenzer I, Covinsky KE. Skin cancer in U.S. elderly adults: does life expectancy play a role in treatment decisions? *J Am Geriatr Soc.* 2016;64:1610-1615.

AUTHOR CORRESPONDENCE

Isabelle Raymond PhD

E-mail:..... iraymond@sensushealthcare.com

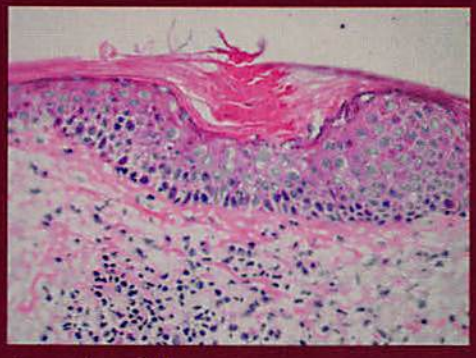
ISSN: 1545 9616

February 2020 • Volume 19 • Issue 2

JOURNAL OF DRUGS IN DERMATOLOGY

JDD

DRUGS • DEVICES • METHODS



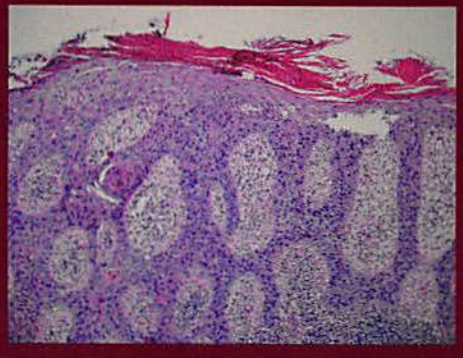


Image credit page 205

RESIDENT ROUNDS • NEWS, VIEWS, & REVIEWS • PIPELINE PREVIEWS • CLINICAL TRIAL REVIEW

ANTI-AGING · AESTHETIC · MEDICAL DERMATOLOGY