Table 3. Failure modes and effects analysis (FMEA) of skin lesions treatment process using Esteya in chronological order of steps. The values in parentheses are mean values prior to the introduction of the quality management tools, while values outside the parentheses are those following the introduction of these tools. The 21 FMs that had risk priority number (RPN) ≥ 50 after the application of quality management tools are marked in grey

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
1	Patient selection	Inadequate selection	Not sufficient training	Suboptimal treatment	(3.1) 1	5.0	(6.9) 2	(96.7) 10	Esteya instead of another technique
2	Patient selection	Inadequate selection	Not sufficient training	Suboptimal treatment	(3.1) 1	5.0	(6.9) 2	(96.7) 10	Another technique instead of Esteya
3	Patient selection	Inadequate selection	Inattention	Suboptimal treatment	(4.0) 3	5.0	(6.9) 2	(146.7) 30	Esteya instead of another technique
4	Patient selection	Inadequate selection	Inattention	Suboptimal treatment	(3.9) 3	5.0	(6.9) 2	(141.6) 30	Another technique instead of Esteya
5	Patient selection	Inadequate selection	Heavy patient workload	Suboptimal treatment	(4.0) 4	5.0	(6.9) 3	(146.7) 60	Esteya instead of another technique
6	Patient selection	Inadequate selection	Heavy patient workload	Suboptimal treatment	(3.9) 4	5.0	(6.9) 3	(141.6) 60	Another technique instead of Esteya
7	General preparation	No patient agreement document	Not sufficient training	Legal issues	(3.1) 1	1.7	(2.4) 1	(13.4) 2	
8	General preparation	No patient agreement document	Inattention	Legal issues	(4.4) 3	1.7	(2.4) 1	(17.7) 5	
9	General preparation	Wrong treatment explanation to the patient	Not sufficient training	Legal issues Patient inconvenience	(3.4) 1	2.0	(4.0) 1	(29.1) 2	
10	General preparation	Wrong treatment explanation to the patient	Inattention	Legal issues Patient inconvenience	(4.1) 3	2.0	(3.9) 1	(31.6) 6	
11	Imaging	Inadequate image	Not sufficient training	Wrong dose distribution	(3.4) 1	6.0	(6.0) 2	(112.3) 12	
12	Imaging	Inadequate image	Inattention	Wrong dose distribution	(3.9) 3	6.0	(6.1 2	(146.9) 36	
13	Imaging	Inadequate image	Heavy patient workload	Wrong dose distribution	(3.9) 4	6.0	(6.0) 3	(144.9) 72	
14	Imaging	Inadequate image	Equipment or software malfunction	Wrong dose distribution	(2.9) 3	6.0	(6.4) 2	(105.4) 36	
15	Depth definition	Wrong depth definition	Not sufficient training	Wrong dose distribution	(3.1) 1	6.0	(6.6) 2	(120.6) 12	
16	Depth definition	Wrong depth definition	Inattention	Wrong dose distribution	(3.6) 3	6.0	(6.7) 2	(155.1) 36	
17	Depth definition	Wrong depth definition	Heavy patient workload	Wrong dose distribution	(3.9) 4	6.0	(6.6) 3	(160.0) 72	
18	Depth definition	Assignment of lesion depth to another lesion	Not sufficient training	Wrong dose distribution	(2.6) 1	6.6	(6.1) 2	(97.4) 13	

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
19	Depth definition	Assignment of lesion depth to another lesion	Inattention	Wrong dose distribution	(3.3) 2	6.4	(6.1) 2	(134.9) 26	
20	Depth definition	Assignment of lesion depth to another lesion	Heavy patient workload	Wrong dose distribution	(3.3) 3	6.4	(6.1) 3	(137.1) 58	
21	GTV definition	Wrong GTV definition	Not sufficient training	Wrong dose distribution	(2.7) 1	6.3	(4.3) 1	(70.1) 6	
22	GTV definition	Wrong GTV definition	Inattention	Wrong dose distribution	(3.3) 2	6.3	(4.4) 1	(86.6) 13	
23	GTV definition	Wrong GTV definition	Heavy patient workload	Wrong dose distribution	(3.4) 3	6.3	(4.3) 2	(88.7) 38	
24	GTV definition	Incorrect lesion location	Not sufficient training	Wrong treatment delivery	(2.9) 1	6.7	(3.7) 1	(72.6) 7	A lesion that should not be treated was treated
25	GTV definition	Incorrect lesion location	Inattention	Wrong treatment delivery	(3.4) 2	6.7	(4.0) 1	(91.4) 13	A lesion that should not be treated was treated
26	GTV definition	Incorrect lesion location	Heavy patient workload	Wrong treatment delivery	(3.4) 3	6.7	(3.7) 2	(88.6) 40	A lesion that should not be treated was treated
27	GTV definition	Incorrect lesion location	Not sufficient training	Wrong treatment delivery	(2.6) 1	6.9	(3.6) 1	(64.0) 7	A lesion that should not be treated was treated
28	GTV definition	Incorrect lesion location	Inattention	Wrong treatment delivery	(3.1) 2	6.9	(3.9) 1	(83.4) 14	A lesion that should not be treated was treated
29	GTV definition	Incorrect lesion location	Heavy patient workload	Wrong treatment delivery	(3.1) 3	6.9	(3.6) 2	(80.0) 41	A lesion that should not be treated was treated
30	CTV definition	Wrong CTV definition (margin)	Not sufficient training	Wrong dose distribution	(2.7) 1	6.1	(4.9) 1	(80.1) 6	
31	CTV definition	Wrong CTV definition (margin)	Inattention	Wrong dose distribution	(3.3) 2	6.1	(5.0) 1	(96.0) 12	
32	CTV definition	Wrong CTV definition (margin)	Heavy patient workload	Wrong dose distribution	(3.6) 4	6.1	(4.9) 2	(104.1) 49	
33	PTV definition	Wrong PTV definition (margin)	Not sufficient training	Wrong dose distribution	(2.9) 1	6.1	(5.0) 1	(89.6) 6	
34	PTV definition	Wrong PTV definition (margin)	Inattention	Wrong dose distribution	(3.3) 2	6.1	(5.1) 1	(97.7) 12	
35	PTV definition	Wrong PTV definition (margin)	Heavy patient workload	Wrong dose distribution	(3.6) 4	6.1	(5.0) 2	(106.7) 49	

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
36	Prescription report	Wrong total dose	Not sufficient training	Wrong absolute dose	(2.6) 1	6.6	(3.7) 1	(60.3) 7	
37	Prescription report	Wrong total dose	Inattention	Wrong absolute dose	(3.4) 2	6.6	(3.7) 1	(83.6) 13	
38	Prescription report	Wrong total dose	Heavy patient workload	Wrong absolute dose	(3.7) 4	6.6	(3.7) 2	(89.3) 53	
39	Prescription report	Wrong dose per fraction	Not sufficient training	Wrong absolute dose	(2.7) 1	6.4	(3.9) 1	(67.4) 6	
40	Prescription report	Wrong dose per fraction	Inattention	Wrong absolute dose	(3.4) 2	6.4	(3.9) 1	(85.7) 13	
41	Prescription report	Wrong dose per fraction	Heavy patient workload	Wrong absolute dose	(3.9) 4	6.4	(3.9) 2	(97.1) 51	
42	Prescription report	Wrong fraction	Not sufficient training	Wrong absolute dose	(2.6) 1	6.3	(3.9) 1	(61.1) 6	
43	Prescription report	Wrong fraction	Inattention	Wrong absolute dose	(3.6) 3	6.3	(3.9) 1	(90.6) 19	
44	Prescription report	Wrong fraction	Heavy patient workload	Wrong absolute dose	(3.9) 4	6.3	(3.9) 2	(96.3) 50	
45	Prescription report	Wrong depth	Not sufficient training	Wrong dose distribution	(2.7) 1	6.1	(6.6) 1	(98.6) 6	
46	Prescription report	Wrong depth	Inattention	Wrong dose distribution	(3.7) 3	6.1	(6.6) 1	(165.0) 18	
47	Prescription report	Wrong depth	Heavy patient workload	Wrong dose distribution	(4.0) 4	6.1	(6.6) 2	(170.7) 49	
48	Prescription report	Wrong applicator	Not sufficient training	Wrong dose distribution	(2.7) 1	6.1	(4.1) 1	(67.6) 6	
49	Prescription report	Wrong applicator	Inattention	Wrong dose distribution	(3.6) 3	6.1	(4.1) 1	(92.7) 18	
50	Prescription report	Wrong applicator	Heavy patient workload	Wrong dose distribution	(3.9) 4	6.1	(4.1) 2	(98.4) 49	
51	Prescription report	Wrong patient data	Not sufficient training	Wrong treatment delivery	(2.7) 1	6.7	(3.9) 1	(67.1) 7	
52	Prescription report	Wrong patient data	Inattention	Wrong treatment delivery	(3.4) 2	6.7	(3.9) 1	(92.4) 13	
53	Prescription report	Wrong patient data	Heavy patient workload	Wrong treatment delivery	(3.7) 4	6.7	(3.9) 2	(98.1) 54	
54	Prescription report	Wrong lesion in a patient with multiple lesions	Not sufficient training	Wrong treatment delivery	(2.9) 1	6.6	(6.0) 2	(98.0) 13	
55	Prescription report	Wrong lesion in a patient with multiple lesions	Inattention	Wrong treatment delivery	(4.0) 3	6.6	(6.0) 2	(171.9) 39	
56	Prescription report	Wrong lesion in a patient with multiple lesions	Heavy patient workload	Wrong treatment delivery	(4.3) 4	6.6	(6.0) 3	(177.6) 79	

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O		S	D		RPN		Notes and examples
57	Patient data entry	Wrong patient ID	Not sufficient training	Wrong treatment delivery	(2.3)	1	4.6	(4.0)	1	(36.9)	5	
58	Patient data entry	Wrong patient ID	Inattention	Wrong treatment delivery	(3.4)	2	4.6	(4.1)	1	(63.4)	9	
59	Patient data entry	Wrong patient ID	Heavy patient workload	Wrong treatment delivery	(3.7)	4	4.6	(4.0)	2	(65.0)	37	
60	Patient data entry	Wrong photo of a patient	Not sufficient training	Wrong treatment delivery	(2.1)	1	3.3	(1.7)	1	(14.9)	3	
61	Patient data entry	Wrong photo of a patient	Inattention	Wrong treatment delivery	(3.3)	2	3.3	(1.9)	1	(21.7)	7	
62	Patient data entry	Wrong photo of a patient	Heavy patient workload	Wrong treatment delivery	(3.4)	3	3.3	(1.7	2	(21.6	20	
63	Applicator selection	Inadequate applicator	Not sufficient training	Wrong absolute dose	(2.9)	1	6.0	(3.7)	1	(58.9)	6	
64	Applicator selection	Inadequate applicator	Inattention	Wrong absolute dose	(3.7)	3	6.0	(3.9)	1	(85.7)	18	
65	Applicator selection	Inadequate applicator	Heavy patient workload	Wrong absolute dose	(4.0)	4	6.0	(3.7)	2	(88.6)	48	
66	Prescription data entry	Wrong fraction number	Not sufficient training	Wrong treatment delivery	(2.4)	1	6.3	(3.6)	1	(55.0)	6	
67	Prescription data entry	Wrong fraction number	Inattention	Wrong treatment delivery	(3.6)	3	6.3	(3.7)	1	(85.1)	19	
68	Prescription data entry	Wrong fraction number	Heavy patient workload	Wrong treatment delivery	(3.6)	4	6.3	(3.6)	2	(84.6)	50	
69	Prescription data entry	Wrong doses per fraction	Not sufficient training	Wrong treatment delivery	(2.4)	1	6.7	(3.6)	1	(58.6)	7	
70	Prescription data entry	Wrong doses per fraction	Inattention	Wrong treatment delivery	(3.4)	2	6.7	(3.7)	1	(88.6)	13	
71	Prescription data entry	Wrong doses per fraction	Heavy patient workload	Wrong treatment delivery	(3.7)	4	6.7	(3.6)	2	(91.0)	54	
72	Prescription data entry	Wrong depth	Not sufficient training	Wrong dose distribution	(2.3)	1	6.9	(5.6)	2	(89.0)	14	
73	Prescription data entry	Wrong depth	Inattention	Wrong dose distribution	(3.1)	2	6.9	(5.7)	2	(144.4)	27	
74	Prescription data entry	Wrong depth	Heavy patient workload	Wrong dose distribution	(3.3)	3	6.9	(5.6)	3	(145.1)	62	
75	Prescription data entry	Wrong applicator	Not sufficient training	Wrong dose distribution	(2.6)	1	6.7	(3.7)	1	(65.7)	7	
76	Prescription data entry	Wrong applicator	Inattention	Wrong dose distribution	(3.4)	2	6.7	(3.9)	1	(91.1)	13	
77	Prescription data entry	Wrong applicator	Heavy patient workload	Wrong dose distribution	(3.6)	4	6.7	(3.7)	2	(91.9)	54	
78	Prescription data entry	Wrong lesion photo	Not sufficient training	Wrong dose distribution	(2.6)	1	3.3	(2.4)	1	(19.7)	3	Photo of the lesion was confused by the photo of a lesion of another patient

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
79	Prescription data entry	Wrong lesion photo	Inattention	Wrong dose distribution	(3.6) 3	3.3	(2.6) 1	(26.3) 10	Photo of the lesion was confused by the photo of a lesion of another patient
80	Prescription data entry	Wrong lesion photo	Heavy patient workload	Wrong dose distribution	(3.7) 4	3.3	(2.4) 2	(26.4) 26	Photo of the lesion was confused by the photo of a lesion of another patient
81	Prescription data entry	Wrong lesion photo in a patient with multiple lesions	Not sufficient training	Wrong treatment delivery	(2.4) 1	3.3	(3.0) 1	(23.4) 3	Lesion photo was confused with another lesion of the same patient
82	Prescription data entry	Wrong lesion photo in a patient with multiple lesions	Inattention	Wrong treatment delivery	(3.6) 3	3.3	(3.1) 1	(33.4) 10	Lesion photo was confused with another lesion of the same patient
83	Prescription data entry	Wrong lesion photo in a patient with multiple lesions	Heavy patient workload	Wrong treatment delivery	(3.7) 4	3.3	(3.0) 2	(33.7) 26	Lesion photo was confused with another lesion of the same patient
84	Treatment time calculation	Wrong calculated time	Equipment or software malfunction	Wrong treatment delivery	(3.0) 3	6.6	(5.7) 1	(118.9) 20	
85	Equipment switch on	Wrong switch on	Not sufficient training	Wrong treatment delivery	(2.9) 1	4.9	(1.4) 1	(17.1) 5	The equipment could not turn on and the patient was not treated
86	Equipment switch on	Wrong switch on	Equipment or software malfunction	Wrong treatment delivery	(2.9) 3	4.9	(1.4) 1	(17.4) 15	The equipment could not turn on and the patient was not treated
87	Equipment switch on	Wrong switch on	Not sufficient written procedures	Wrong treatment delivery	(2.6) 1	4.9	(1.9) 1	(19.4) 5	The equipment could not turn on and the patient was not treated
88	Equipment switch on	Connectivity failure	Not sufficient training	Wrong treatment delivery	(3.0) 1	4.9	(1.4) 1	(18.1) 5	
89	Equipment switch on	Connectivity failure	Equipment or software malfunction	Wrong treatment delivery	(2.9) 3	4.9	(1.4) 1	(17.4) 15	
90	Equipment switch on	Connectivity failure	Not sufficient written procedures	Wrong treatment delivery	(2.7) 1	4.9	(1.9) 1	(20.4) 5	
91	Self-test	Self-test failure	Equipment or software malfunction	Wrong absolute dose	(2.7) 3	6.1	(2.4) 1	(40.9) 18	Equipment did pass the *self-test* when it should not pass it. Failure: *PC free memory, PC free disk space, control unit resources*. The treatment was delivered but was not recorded

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
92	Self-test	Self-test failure	Equipment or software malfunction	Inconvenience-patient	(2.9) 3	4.3	(1.4) 1	(16.0) 13	Equipment did pass the *self-test* when it should not pass it. Failure: *power supply voltage, generator connection, emergency stop status, connectivity primary and secondary controllers, generator connection, generator status, X-ray applicator connection.* The tube did not fire, patient treatment was delayed but was treated that day
93	Self-test	Self-test failure	Equipment or software malfunction	Suboptimal plan	(2.9) 3	5.7	(4.9) 1	(87.1) 17	Equipment did pass the *self-test* when it should not pass it. Failure: *power supply voltage, generator connection, emergency stop status, connectivity primary and secondary controllers, generator connection, generator status, X-ray applicator connection.* The tube did not fire, the patient was not treated for a few days
94	Self-test	Self-test failure	Equipment or software malfunction	Wrong absolute dose	(2.7) 3	6.6	(6.3) 1	(110.3) 20	Equipment did pass the *self-test* when it should not pass it. Failure: *surface applicator detection, cooling system temperature, cooling system level, cooling system flow, source condition status.* The tube fired but shooting conditions were not correct
95	Source condition status	Source condition status failure	Equipment or software malfunction	Wrong absolute dose	(2.7) 3	6.6	(3.4) 1	(58.9) 20	Equipment did pass the *source condition status* when it should not pass it. The tube was not conditioned
96	Source condition status	Source condition status failure	Equipment or software malfunction	Inconvenience-patient	(2.4) 2	4.4	(1.7) 1	(17.7) 9	Equipment did not pass the *source condition status* when it should pass it. The problem was solved. Patient treatment was delayed but delivered that day
97	Source condition status	Source condition status failure	Equipment or software malfunction	Suboptimal plan	(2.9) 3	5.0	(2.3) 1	(30.7) 15	Equipment did not pass the *source condition status* when it should pass it. The problem was not solved, patient was not treated that day

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
98	Quality check status	Quality check status failure	Equipment or software malfunction	Wrong treatment delivery	(2.7) 3	6.3	(6.7) 2	(113.7) 38	Equipment did pass the *quality check status* when it should not pass it
99	Quality check status	Quality check status failure	Equipment or software malfunction	Inconvenience-patient	(2.7) 3	4.4	(2.3) 1	(22.9) 13	Equipment did not pass the *quality check status* when it should pass it. The problem was solved, patient treatment was delayed but delivered that day
100	Quality check status	Quality check status failure	Equipment or software malfunction	Suboptimal plan	(2.7) 3	5.4	(2.3) 1	(37.1) 16	Equipment did not pass the *quality check status* when it should pass it. The problem was not solved, patient was not treated that day
101	Load treatment session data	Wrong data pat load	Not sufficient training	Wrong treatment delivery	(3.3) 1	6.3	(5.9) 2	(101.4) 13	
102	Load treatment session data	Wrong data pat load	Equipment or software malfunction	Wrong treatment delivery	(3.0) 3	6.3	(6.0) 2	(117.9) 38	
103	Load treatment session data	Wrong data pat load	Not sufficient written procedures	Wrong treatment delivery	(3.1) 3	6.3	(5.6) 2	(121.0) 38	
104	Load treatment session data	Wrong lesion in a patient with multiple lesions	Not sufficient training	Wrong treatment delivery	(3.1) 1	6.3	(5.7) 2	(95.0) 13	
105	Load treatment session data	Wrong lesion in a patient with multiple lesions	Equipment or software malfunction	Wrong treatment delivery	(3.0) 3	6.3	(6.1) 2	(120.7) 38	
106	Load treatment session data	Wrong lesion in a patient with multiple lesions	Not sufficient written procedures	Wrong treatment delivery	(3.1) 1	6.3	(5.6) 2	(121.0) 13	
107	Applicator placement	Inadequate applicator	Not sufficient training	Wrong dose distribution	(2.9) 1	6.3	(5.6) 1	(89.6) 6	An applicator was confused with another
108	Applicator placement	Inadequate applicator	Inattention	Wrong dose distribution	(3.4) 2	6.3	(5.7) 1	(140.1) 13	An applicator was confused with another
109	Applicator placement	Inadequate applicator	Heavy patient workload	Wrong dose distribution	(3.7) 4	6.3	(5.6) 1	(141.6) 25	An applicator was confused with another
110	Applicator placement	Inadequate applicator	Applicator ID deteriorated	Wrong dose distribution	(3.6) 4	6.3	(5.7) 1	(142.7) 25	An applicator was confused with another
111	Applicator placement	Wrong applicator setting	Not sufficient training	Wrong dose distribution	(2.7) 1	6.1	(5.7) 1	(86.9) 6	Incorrect position of the applicator
112	Applicator placement	Wrong applicator setting	Equipment or software malfunction	Wrong dose distribution	(3.4) 3	6.1	(5.9) 1	(126.3) 18	Incorrect position of the applicator

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
113	Applicator placement	Wrong applicator setting	Not sufficient written procedures	Wrong dose distribution	(3.6) 2	6.1	(5.7) 1	(144.7) 12	Incorrect position of the applicator
114	Applicator placement	Inadequate applicator cover position	Not sufficient training	Wrong dose distribution	(3.0) 1	6.0	(3.9) 1	(66.0) 6	
115	Applicator placement	Inadequate applicator cover position	Inattention	Wrong dose distribution	(3.9) 3	6.0	(4.0) 1	(89.0) 18	
116	Applicator placement	Inadequate applicator cover position	Heavy patient workload	Wrong dose distribution	(4.0) 4	6.0	(3.7) 1	(87.6) 24	
117	Applicator placement	Inadequate applicator cover position	Equipment or software malfunction	Wrong dose distribution	(3.3) 3	6.0	(3.9) 1	(73.1) 18	
118	Patient positioning	Uncomfort-able patient position	Not sufficient training	Inconve-nience-pa-tient	(3.7) 2	2.1	(5.4) 3	(37.7) 13	Patient was uncomfortable but maintained the same position during the treatment
119	Patient positioning	Uncomfort-able patient position	Inattention	Inconve-nience-pa-tient	(3.7) 3	2.1	(5.4) 3	(41.4) 19	Patient was uncomfortable but maintained the same position during the treatment
120	Patient positioning	Uncomfort-able patient position	Heavy patient workload	Inconve-nience-pa-tient	(4.0) 4	2.1	(5.4) 4	(42.9) 34	Patient was uncomfortable but maintained the same position during the treatment
121	Patient positioning	Patient movement	Uncomfort-able patient position	Wrong dose distribution	(3.9) 4	6.3	(5.4) 4	(141.0) 101	
122	Patient positioning	Patient movement	No sufficient attachment elements	Wrong dose distribution	(4.0) 4	6.3	(5.4) 4	(144.3) 101	
123	Lesion state assessment	Wrong lesion in a patient with multiple lesions	Not sufficient training	Wrong treat-ment delivery	(2.7) 1	6.3	(5.7) 2	(87.7) 13	
124	Lesion state assessment	Wrong lesion in a patient with multiple lesions	Inattention	Wrong treat-ment delivery	(3.6) 3	6.3	(5.9) 2	(143.6) 38	
125	Lesion state assessment	Wrong lesion in a patient with multiple lesions	Heavy patient workload	Wrong treat-ment delivery	(3.9) 4	6.3	(5.7) 3	(147.3) 75	
126	Transparent film placement	No transparent film collocation	Not sufficient training	Skin infection	(2.7) 1	3.9	(2.6) 1	(42.0) 4	

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
127	Transparent film placement	No transparent film collocation	Inattention	Skin infection	(3.6) 3	3.9	(2.7) 1	(42.9) 12	
128	Transparent film placement	No transparent film collocation	Heavy patient workload	Skin infection	(3.7) 4	3.9	(2.6) 2	(44.6) 31	
129	X-ray tube positioning	Offset X-ray tube	Not sufficient training	Wrong dose distribution	(3.1) 1	6.4	(4.3) 1	(79.4) 6	X-ray tube was offset from the lesion
130	X-ray tube positioning	Offset X-ray tube	Inattention	Wrong dose distribution	(4.0) 3	6.4	(4.4) 2	(108.6) 39	X-ray tube was offset from the lesion
131	X-ray tube positioning	Offset X-ray tube	Heavy patient workload	Wrong dose distribution	(4.3) 4	6.4	(4.3) 2	(114.0) 51	X-ray tube was offset from the lesion
132	X-ray tube positioning	Insufficient pressure	Not sufficient training	Wrong dose distribution	(3.1) 1	6.3	(4.4) 1	(82.3) 6	X-ray tube was not placed with enough pressure, an air gap between the head and the lesion was generated. No uniformity was generated on the input surface of lesion
133	X-ray tube positioning	Insufficient pressure	Inattention	Wrong dose distribution	(3.7) 3	6.3	(4.6) 5	(106.0) 94	X-ray tube was not placed with enough pressure, an air gap between the applicator surface and the lesion was generated. No uniformity was generated on the input surface of lesion
134	X-ray tube positioning	Insufficient pressure	Heavy patient workload	Wrong dose distribution	(4.0) 4	6.3	(5.0) 5	(126.3) 126	X-ray tube was not placed with enough pressure, an air gap between the applicator surface and the lesion was generated. No uniformity was generated on the input surface of lesion
135	X-ray tube positioning	Insufficient pressure	Equipment or software malfunction	Wrong dose distribution	(3.1) 3	6.3	(3.9) 4	(84.3) 75	X-ray tube was placed with enough pressure but it lost the pressure during treatment, an air gap between the applicator surface and the lesion was generated. No uniformity was generated on the input surface of lesion
136	Treatment delivery	Incomplete treatment delivery	Equipment or software malfunction	Wrong absolute dose	(3.1) 3	6.1	(3.9) 1	(80.3) 18	Treatment was stopped without completing the time of treatment. The patient left without completing treatment
137	Treatment delivery	Interruption of treatment delivery	Equipment or software malfunction	Inconvenience-patient	(3.0) 3	3.0	(1.6) 1	(18.9) 9	Treatment was stopped and continued later. The treatment time was lengthened

Table 3. Cont.

#	Step	Failure mode	Cause	Effect	O	S	D	RPN	Notes and examples
138	Treatment delivery	Excessive treatment time	Equipment or software malfunction	Wrong absolute dose	(3.3) 3	7.0	(3.9) 1	(89.7) 21	
139	Treatment delivery	Inadequate treatment parameters (kV, mA)	Equipment or software malfunction	Wrong absolute dose	(3.0) 3	6.7	(6.3) 1	(134.0) 20	Failure of equipment parameters: kV, mA, spectrum, etc.
140	Treatment record	Treatment record in other treatment patient	Equipment or software malfunction	Wrong absolute dose	(3.4) 3	5.1	(2.4) 1	(35.9) 15	Treatment was recorded on another patient
141	Treatment record	No treatment record	Equipment or software malfunction	Wrong absolute dose	(3.3) 3	5.4	(2.4) 1	(38.4) 16	Treatment was not recorded. This session was not subtracted of the total sessions
142	Treatment report	No treatment report	Equipment or software malfunction	Inconvenience of staff	(2.9) 3	2.6	(2.3) 1	(15.1) 8	
143	Treatment report	Wrong treatment report	Equipment or software malfunction	Inconvenience of staff	(2.9) 3	2.6	(2.6) 1	(15.7) 8	Incorrect patient data or another information
144	Treatment report	No save treatment report	Not sufficient training	Inconvenience of staff	(2.9) 1	2.6	(2.9) 1	(17.4) 3	
145	Treatment report	No save treatment report	Inattention	Inconvenience of staff	(3.7) 3	2.6	(3.0) 2	(22.6) 15	
146	Treatment report	No save treatment report	Heavy patient workload	Inconvenience of staff	(4.0) 4	2.6	(2.9) 2	(23.4) 21	