dartschSCIENTIFIC
INSTITUT FÜR ZELLBIOLOGISCHE TESTSYSTEME

Dartsch Scientific GmbH · Auf der Voßhardt 25 · D-49419 Wagenfeld

Qi - Technologies GmbH
Bahnhofstraße 16

D – 02625 Bautzen, Germany

Auf der Voßhardt 25
D-49419 Wagenfeld, Germany

Fon: +49 5444 980 1322
Mobil: +49 151 2272 1294
Email: info@dartsch-scientific.com
Web: www.dartsch-scientific.com

Dezember 31, 2019

TEST REPORT
Neutralisation of mobile phone radiation by Qi-Shield©
Examinations with cultured connective tissue fibroblasts

1 Background and question of the investigation

According to the homepage of the provider, Qi-Shield© was designed to protect „against all types of radiation“ and „can be used for both portable and stationary protection“. In this study, we examined the effect of non-thermal radiation emitted by an active mobile phone on cell regeneration/wound healing *in vitro*. In addition, the protective effect of a Qi-Shield© was evaluated under the same experimental conditions.

2 Experimental design

In vivo, the wound healing process can be divided in three distinct phases: Cleaning phase, granulation phase and differentiation phase. Especially the granulation phase, which is characterised by the occurrence of cell migration and cell proliferation of fibroblasts for defect filling, is simulated here to examine the effect of non-thermal radiation ± Qi-Shield© by an active mobile phone.

The examinations were performed with connective tissue fibroblasts of cell line L-929 (ACC-2, Leibniz Institute DSMZ, Braunschweig, Germany) and used in passages 81 to 85. Cells were routinely cultured in RPMI 1640 with 10 % growth mixture and 0.5 % gentamycin and cultivated in an incubator at 37 °C with an atmosphere of 5 % CO_2 and 95 % air and a humidity of approximately 100 %.

Fibroblasts were seeded at a density of 50,000 cells/ml into the three individual compartments of a silicone 3 well-culture insert made (ibidi, Gräfelfing, Germany). The single compartments of the inserts are separated by a 500 µm thick silicone bar with an outer silicone frame of 700 µm. Due to the special adhesion area, an insert adheres firmly to the bottom

of a culture dish and forms a distinct cell-free area (artificial wound), which the cells can colonise by migration and proliferation. Upon reaching confluency within 48 hours after cell seeding, the silicone inserts were carefully removed with tweezers to achieve a sharp wound edge of the cell-free space between the compartments. The normal culture medium was replaced to 1 ml of Leibowitz L-15 medium with 1 % growth mixture and 0.5 % gentamycin and cell cultures were transfered to 2 separated incubators of 37 °C, but without gassing, for radiation exposure and untreated control. The incubators were located in different areas of the lab with a distance of more than 20 meters, so that the Qi-Shield© was unable to influence the control cultures.

During the first 2 hours of wound closure, cells were exposed to the non-thermal radiation emitted by an active mobile phone ± Qi-Shield©. The Qi-Shield© was placed in a distance of 30 cm to the cell cultures besides the incubator. In order to avoid thermal effects of the active mibile phone, a cardboard (thickness 5 mm) was placed between the culture dish and the active mobile phone which was located on the cardboard within the incubator. After the exposure period was finished, L-15 medium was replaced by normal culture medium and the cell cultures were incubated at standard conditions with 2 ml of culture medium for another 22 hours to allow the cells to migrate and proliferate into the cell-free space. Then, cells were fixed with 100 % methanol, stained with a Giemsa's azur eosin methylene blue solution (Merck, Darmstadt, Germany), were air-dried and the width of the remaining cell-free area was measured by micrographical methods. Wound edge measurements were made at 6 different positions for each cell culture and the resulting mean value in comparison to the corresponding unexposed control culture was taken for the final assessment. In order to eliminate any influence of the incubator or of the environment, experiments were also performed by changing the incubators and locations between the exposed cultures and the control cultures.

Altogether, 6 independent experiments were conducted with 2 experiments with exchanged incubators and locations. Statistical analysis of the combined data of all test assays was done using two-tailed Wilcoxon-Mann-Whitney test.

3 Results

Measurement of the surface temperature at the cover of the cell culture plate with an infrared thermometer resulted only in a slight overtemperature of not more than 38.0 °C. So we concluded that the experimental design omitted any thermal effects influencing the cell cultures.

As depicted in Figure 1, the non-thermal radiation emitted by an active mobile phone caused a nearly complete loss in the migratory and proliferative activity of the cells leaving the cell-free space unclosed. In contrast, the cell-free space of the untreated control was nearly closed. Moreover, not only cell migration, but also cell integrity, was largely affected by the radiation. This was represented by a strongly decreased staining of the cytoplasm

of the cells. In contrast, the use of a Qi-Shield© resulted in a very small cell-free space which was nearly similar to the untreated control.
In accordance with the morphological observations were the quantified data of the 6 independent experiments which are shown in Table 1 in detail. In order to examine if the used incubator or the location of the incubator can influence the experiments, a change of both parameters was performed in two experiments. As shown in the table, this change in the experimental setup did not produce other results than before.
When taking all experiments together, the residual wound edge for the untreated controls was 199 ± 20.2 µm (mean value ± standard deviation; n = 6). The wound edge for the unprotected cells was 408 ± 45.3 µm (mean value ± standard deviation; n = 6) and for the Qi-Shield©-protected cells 227 ± 32.3 µm (mean value ± standard deviation; n = 6). This means that there was no statistically significant difference between the untreated control and the Qi-Shield©-protected cells, but a statistically significant difference between the the Qi-Shield©-protected cells and the unprotected cells ($p < 0,05$; Wilcoxon-Mann-Whitney test). When looking at the relative values in comparison to the control, cell regeneration was decreased by only 13.6 ± 10.6 % (mean value ± standard deviation; n = 6) by use of the Qi-Shield©, but was decreased by 102.9 ± 7.2 % (mean value ± standard deviation; n = 6) for the unprotected cell cultures. There was no statistically significant difference between the control cultures and the Qi-Shield©-protected cultures.

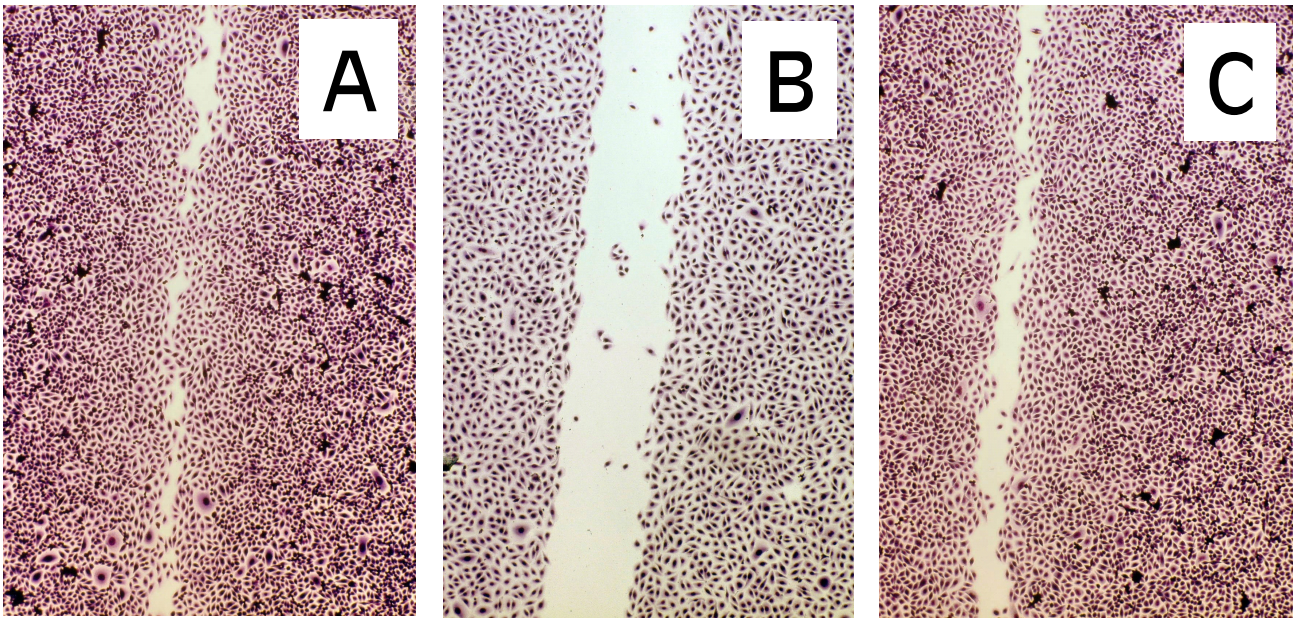

Figure 1: Micrographs of regeneration/wound healing of connective tissue fibroblasts. (A) Untreated control culture; (B) Mobile phone-treated culture for 2 hours; (C) Mobile phone-treated culture for 2 hours with protection by Qi-Shield©. Olympus IX 50 with Planachromate 10x and an Olympus E-10 digital camera at 4 megapixel at bright field illumination.

Table 1: Presentation of the measurement data of all 6 independent experiments done within a total experimental period of 4 weeks. The experiments marked by an asteriks were done by exchange of the incubators and the location for control cultures and irradiated cultures ± Qi-Shield©.

Experiment No	Sample	Remaining cell-free space (singe values in µm)						Mean in µm	±	S.D. in µm	Mean in %	±	S.D. in %
1	Ctrl	190	174	193	153	174	204	181	±	18	100,0	±	10,0
	w/o Qi-Shield	410	371	387	406	352	387	386	±	22	212,6	±	5,6
	with Qi-Shield	193	213	185	170	193	217	195	±	18	107,6	±	9,0
2*	Ctrl	220	147	170	154	193	194	180	±	28	100,0	±	15,4
	w/o Qi-Shield	328	371	372	347	324	317	343	±	24	191,0	±	7,0
	with Qi-Shield	201	212	236	239	158	174	203	±	33	113,2	±	16,1
3	Ctrl	189	204	206	162	202	156	187	±	22	100,0	±	11,9
	w/o Qi-Shield	444	401	376	389	412	374	399	±	26	214,1	±	6,6
	with Qi-Shield	207	200	186	174	232	197	199	±	20	106,9	±	9,9
4	Ctrl	226	264	194	242	218	241	231	±	24	100,0	±	10,4
	w/o Qi-Shield	489	498	422	486	461	452	468	±	29	202,7	±	6,1
	with Qi-Shield	249	278	282	286	291	215	267	±	29	115,6	±	11,0
5*	Ctrl	201	224	235	197	174	232	211	±	24	100,0	±	11,3
	w/o Qi-Shield	452	455	483	401	427	486	451	±	33	214,1	±	7,3
	with Qi-Shield	284	278	262	267	232	247	262	±	19	124,3	±	7,4
6	Ctrl	224	187	195	206	253	175	207	±	28	100,0	±	13,6
	w/o Qi-Shield	412	395	329	389	447	433	401	±	42	194,0	±	10,4
	with Qi-Shield	221	265	241	257	234	199	236	±	24	114,3	±	10,2

4 Conclusions

The present study has demonstrated that cell regeneration/wound healing is strongly reduced by the non-thermal radiation of an active mobile phone. This effect can be neutralised by approximately 90 % by use of the Qi-Shield© from Qi-Technologies, Bautzen, Germany. From the results, the use of this device can be highly recommended as an effective protection against unwanted irradiation and for the improvement and maintainance of well-being.

Prof. Dr. Peter C. Dartsch
Certified biochemist