

Forman Erwin Siagian_Emergency Light Microscope Modification

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Emergency Light Microscope Simple Modification: Observation Made Possible Even When No Electric Power Supply

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

ABSTRACT

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Introduction: Microscope is an instrument for visualizing fine detail of an object so that observer can observe the object being examined in detail. The object of examination vary from cells (normal or pathologic), microorganism (such as parasite and bacterium), and even non biological part. There are several type of microscope, one of the oldest forms and still used today is the light microscope. A light microscope relied on continuous light source to operate. The most common source for today's microscopes is an incandescent tungsten-halogen bulb, which is solely electric dependent, positioned in a reflective housing that projects light through the collector lens and into the sub stage condenser. Unfortunately, if the electricity goes out, most people will not be able to continue their microscopic observations. Below we propose emergency modification efforts so that the microscope can still be used even in conditions without a power source
Aims: to modify an electric light microscope in such a way that it can continue to be used in the absence of an electrical power source using external source of light
Discussion: Adding an external source of light is a brilliant approach in order to make the electric dependent light microscope still useable in emergency condition.
Conclusion: it is possible to modify an electric light microscope in the condition of no electric source available and make it operable

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Keywords: emergency lamp, positioning. lenses, objective, ocular, magnification, light emitting diode

1. INTRODUCTION

1
The light microscope is an apparatus for apprehending excellent detail of an object being observed [1,2]; by accomplishing a detailed and enlarged portrayal through the use of a sequences of glass lenses [3], which initially adjust a beam of light onto or through an object or section of an object, and flowed thru convex objective lenses to aggrandized the picture captured [4]; in other word, that it accommodates a two-dimensional aggrandized figure of the specimen being observed [3]. In the majority of light microscopes, the image is viewed instantaneously via binocular eyepieces [5] that act as a secondary lens in the form of a

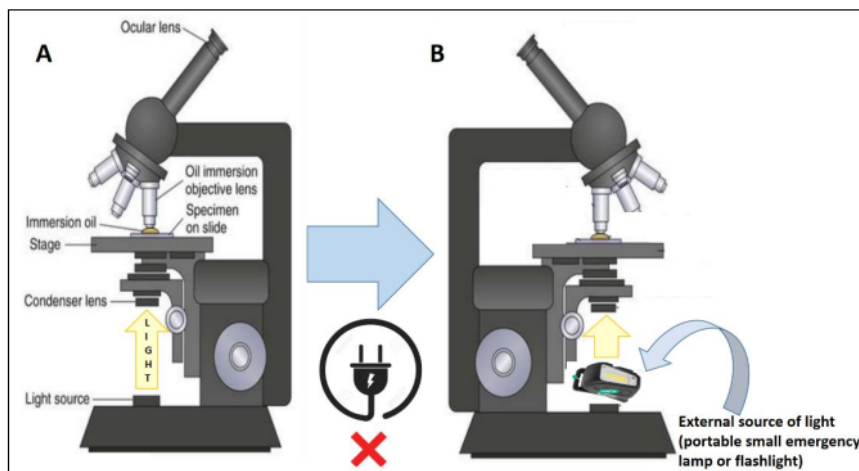
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 30 magnifying glass to observe the projected image [2,4]. Such apparatus are named 'compound
 31 microscopes' [6]. The term magnification means the microscope's ability to make small objects
 32 seem larger, such as making a microscopic organism visible [1,2,6-8]. The total magnification
 33 is the sum of the objective magnification (can be 5x, 10x, 40x or 100x) multiplied with the
 34 eyepiece magnification (usually 10x) [2,7]. The magnification range extends from $\times 10$ to
 35 $\times 1000$, with a resolving power of the order of $0.2 \mu\text{M}$, depending on the type and numerical
 36 aperture (area available for passage of light) of the objective lenses.
 37 Common and regular light microscope rely on light produced from lamp which generated
 38 electrically to operate [2,6,8]. The most frequent source for nowadays microscopes is an
 39 incandescent tungsten-halogen bulb, which is solely electric dependent, positioned in a
 40 reflective housing that projects light through the collector lens and into the sub stage
 41 condenser [5,6]. Unfortunately, if the electricity goes out, most people will not be able to
 42 continue their microscopic observations [9,10].
 43 Below we test the emergency modification efforts so that the light microscope can still be used
 44 properly, even in conditions without an electric power source. This method is applicable in the
 45 field, e.g., when doing field trip, or in limited resources setting.

2. METHODOLOGY

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 49 This approach was developed and perfected during the time of laboratory work in the
 50 department of Parasitology, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta-
 51 Indonesia. We have set a scenario as if it is necessary to carry out a microscopic examination
 52 when there is no electrical power source (for example during a power outage)

53 For the purpose of observation, we prepare light Microscope Olympus CX21 and three
 54 Parasitology positive slides of: (1) *Pediculus humanus capitis*, or the head louse, an obligate
 55 ecto parasite of man; (2) positive thin blood smear of *Plasmodium vivax*, a hemosporozoan
 56 parasite and (3) positive fecal smear of *Entamoeba histolytica* (2 nuclei cyst form). We use
 57 combination of bigger object (*Pediculus humanus capitis*) that can easily be seen ini 10x10 or
 58 10x40 magnification with the smaller *P. vivax* and *E. histolytica* that must use 10x100
 59 magnification.



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 61 1. Schematic part of light microscope.⁷ with modification (A) regular light microscope with its part,
 62 (B) simple modification in case there is no electricity available, it is possible to add external
 63 light source via emergency lamp or flashlight

64 This approach only needed emergency lamp or flashlight from hand phone which is used as
65 a substitute of light source. We use two kind of emergency lamp purchased in a local retail
66 store with specification as follow: the first is a China made APA brand LED 6 watt (32 pcs)
67 white grey emergency lamp equipped with 4V 1600mAh battery, with charging time 12-15
68 hours, duration of use ~up to 4 hours, 220-240 V/50-60 Hz with dimension 5.26×6.3×19cm
69 and the second a LED head lamp PowerLite brand LED 3 watt 120 lumen that use three AAA
70 battery 1,5V and the third is using flashlights from a Samsung A 23 phone cell with Li-Po 5000
71 mAh, non-removable and charging: 25 W wired, LED flash with adjustable brightness. The
72 author disclaimer that any product or device being used in the test are the author's personal
73 individual experiences, reflecting real life experiences. The authors did not receive support
74 from any organization for the submitted work; and all the device used are the author's personal
75 belonging (except for the microscope and the slide).

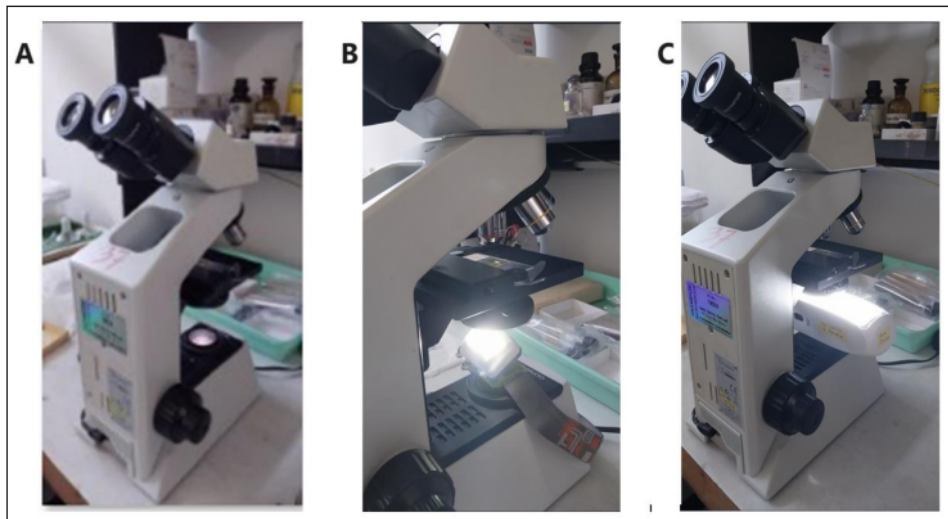
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78 3. RESULTS AND DISCUSSION

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80 As its name implies, the light microscope necessitates sufficient light source, which produces
81 light that can be focused, by a condenser lens, onto the sample [8]. The light that illuminates
82 the specimen reaches a lens known as the objective lens, which creates a magnified image
83 that is inverted, or turned upside down [3].

84 The method being proposed is simple but substantive modification to existing methods. If an
85 electricity power failure scenario occurs, this simple experiment is aimed at replacing the light
86 source from the lamp pre-installed in the microscope with an external light source, in this case
87 an emergency light or cell phone flashlight.
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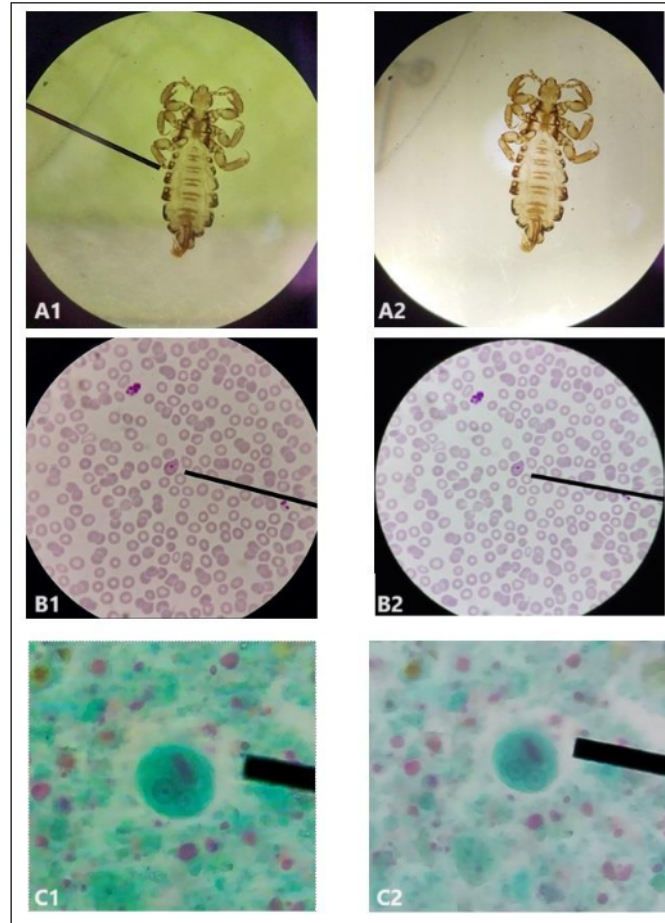
90 Fig 2. (A) regular light microscope, (B) light microscope with external emergency head lamp,
91 (C) microscope with external portable emergency lamp (small size)

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94 To my experience, external source of light very likely to be used and applicable in the condition
95 of no electricity. From the point of view of installation, external head lamp and portable
96 emergency lamp (small size) is the easiest and most convenient to use because users only
97 need to place it on the surface of the existing non-operable lamp and customarily do not

98 require plenty of adjustment. Once it has settled and turned on, all that needs to be done is to
99 make adjustments on the microscope examination table, as is usually done on microscopes
100 in normal working conditions. The output of this small LED emergency lamp is around 6W,
101 and is estimated equal to 400 lumens [11].



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Fig 3. Comparison of parasitic agent taken with cell phone using external emergency head lamp (all the picture with number 1) and small size emergency lamp (all the picture with number 2). (A) *Pediculus humanus capitis* (magnification 10x10), (B) *Plasmodium vivax* mature trophozoite (amoeboid form) magnification 10x100), (C) *Entamoeba histolytica*, cyst form with two nuclei (all slides are courtesy of dept. of Parasitology, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta-Indonesia)

All picture in fig. 3 actually taken in non-standar condition (using external light source) actually showed remarkable result. Eventhough in terms of lighting quality, there is a slight defect in the photo taken using a headlamp as the light source that it seems to have a slightly green tint

115 when compared to those taken using a small emergency lamp. In my opinion, emergency
116 lamp produce a more natural light compared to head lamp.

117 These findings reveal that external lights can be used as an alternative light source, when
118 there is no electricity. The list of advantages includes (1) easy to use, (2) convenience, (3)
119 adjustable to suit user's needs, (4) predictable working time (according to battery life span or
120 after recharging), (5) temporary, non-invasive modifications that will not damage the
121 microscope.

122 Regarding the use of a cellphone flashlight, it turns out that it is not as easy as an emergency
123 light, because in my experience, the cellphone must be held continuously so it does not fall;
124 Apart from that, the light produced by a cellphone flashlight is not as bright as the light from
125 emergency lights. This is understandable because in fact, cell phone flashlights are not
126 designed to produce a specific light beam that is strong enough to shine through the
127 condenser lens. According to Wuben [12] the output of a phone flashlight is estimated around
128 40 lumens; which is about the same as a 2.5W filament bulb. The type of light is diffused and
129 does not have a concentrated beam spot. Because phone flashlight beams also tend to be
130 more spread, they will be less disturbing to eyesight but in the meantime that means cell phone
131 flashlight is not design to make sufficient light beam needed for the microscope.

132 Cellphone flashlights also provide advantages in the field of health examinations [13-15]. The
133 advancement of the high-resolution smartphone camera provides the prospective to alter
134 dramatically the old fashioned but modern table top fundus camera for photography that have
135 its own limitation [14,15]. For example of the advantages is the off-label use of smartphones
136 flashlights for indirect retinal photography and videography that made this approach well
137 received ophthalmic clinical practice for its simplicity, portable, contactless and also
138 universality [13-16] which surely augmented real time tele-medical approach for patient care
139 [27].

140 Smartphone indirect retinal photography necessitates aiming the bright flashlight from the light
141 emitting diode (LED) source available on the rear side of the phone directly on the patient's
142 retina [13,14]. Unfortunately, concerns regarding phototoxic hazards of the bright light,
143 especially with LED lighting, on the already compromised patients' retina raise questions
144 about its safety [18]. A study conducted by Soliman et al [16] revealed that the LED flashlight
145 of the examined smartphones seemed to be inside the limit of safety when used for indirect
146 smartphone retinal photography. However, the high configuration of the minuscule wavelength
147 blue light spectrum could be a concern particularly with prolonged and repeated examinations
148 [19].

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150 It is interesting to explore deeper regarding the application (e.g., during completely dark
151 condition) and placement of external light source in order to get the best visual during
152 observation and also while taking photographs, as the last statement is the limitation of this
153 study.

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156 4. CONCLUSION

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158 This simple method study confirm that an external light source can be used for light microscopy
159 analysis whenever there is no electric source available.

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166 **COMPETING INTERESTS**

167

168 "Authors have declared that no competing interests exist."

169

170 **AUTHORS' CONTRIBUTIONS**

171

172 Author FES solely conduct the whole study from designed the study, performed the analysis,
173 wrote the protocol, and wrote the first draft of the manuscript until the final manuscript."

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175 **CONSENT (WHERE EVER APPLICABLE)**

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177 Not needed

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180 **ETHICAL APPROVAL (WHERE EVER APPLICABLE)**

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