EFFECT ON THE CORNEA STRUCTURE OF THE ULTRAVİOLET EMİTTED FROM THE ARC WELDİNG

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Abstract

Welding is a locally combining process between the contacting surfaces of two metal parts. Due to the frequency of using, especially it can be also addressed in the production process in recent years. While a large part of the arc emits as a heat during welding, others spread into the environment as an ultraviolet radiation caused this heat. The emitted ultraviolet radiation effects on human health depend on the intensity, the energy and the duration time of radiation. These rays are effective in the first and most cornea. A superficial punctate keratitis, typically bilateral, develops early; in severe cases, this objective is frequently followed by total epithelial desquamation. In this study, the 60 patients who have been exposed to the ultraviolet radiation in arc welding have been examined into changes in the structure of the cornea between 2012-2014 time periods. As a result of the examinations, it has been obtained eye pain in %95, eye redness in %5, punctuate keratitis in %100 of patients. Consequently, the wearing glasses has been seen to be reduced the risk of damage on the eyes.

Key words: Welding, Arc, Ultraviolet, Cornea, Punctuate keratitis.

1. Introduction

In general welding is used in the manufacturing, maintenance and repair work as a manufacturing method. It is different form casting or forging. The main principle of this process, it is to add to each other the touching locations of the welded parts by heating up to the melting temperature or using filler material of the same composition [1].

Welding Technology, which rapidly has been improving in parallel with the world of technology, shows new advances day by day. Previously welding technology only was used to in the repair of damaged parts. But today it is production process in space, air, land, sea, and undersea vehicles and in the linking continents pipeline, the foundations of the chemical industry forming pressure vessels and reactors, steam boilers, the construction of nuclear reactors. Welding technology also find application field for the production of not only heavy items as indicated above but also a very small element, for example; used in many electronic devices, such as hundreds diode,

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resistance, output terminals of the integrated circuit comprising circuit elements in the flake size are welded under the microscope by using specific methods [3].

Figure 1. Welding process in the service area. [2].

As it is known today, different welding methods for metallic and non-metallic many materials are applied in combining. In addition, improvements on the welding technology have further accelerated with the developments in electronics and computers. Welding technology has become widespread because of the solution of the mainly initial problem. These new applications of modern welding methods are carried on their development by the new request [4].

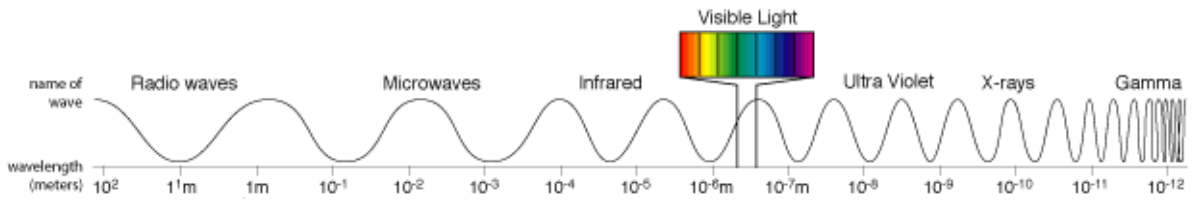
Except for a very small part of welding methods, all methods practically need to be heated until the melting temperature of welding location. Heat sources used in welding technology depend on practices such as electric arc, electric resistance heat, frictional heat, oxy-acetylene flame, or electron beam [5].

Power is the rate of conversion of energy from one to another. When welding arc given, almost all of the electrical energy is converted into heat. Only small parts of the heat emitted by the arc diffuse as bright infrared and ultraviolet rays [6].

1.1.The Risk of The Ray Emitted From Arc Welding

In general, approximately 15% of the arc energy in the welding process spread to the operating environment as a radiation. %10 of energy as ultraviolet, %30 of energy as bright and % 60 of energy as infrared rays spread out environment. These rays are classified by wave length [7]. Each of these rays leads to different health problems for human [1].

Figure 2. Classification of the electromagnetic waves [8].



The ray emitted from arc welding is radiation. The type and quantity of radiation in the welding depend on background processing and the melting temperature of the metal. All radiation is considered as hazardous. Radiation can be classified in two ways, such as, ionized or non-ionized rays. Example of the ionized radiation is X-rays. Electrons occur on electron beam welding. Thorium tungsten electrode used in the TIG welding arise from rupture and fragmentation (these parts are radioactive). Example of the non-ionized radiation is infrared (IR) and UV (ultraviolet) rays. These rays are visible. Infrared radiation result from hot metal flame or arc and it affects just like the heat of burning fuel. Ultraviolet radiation which is not felt by the skin just shows the effect of sunburn on the skin. Wavelength of this radiation is important for the eye health of the employees. Ultraviolet rays cause the most damage in the eyes of employees. It has 4,000 to 8,000 Angstrom (=10 $^{-7}$mm) wavelength and high energy. Unless employees are exposed to this radiation without wearing face shield or frame goggles, they try to protect their eyes from the effects of this radiation by closing or squinting. Ultraviolet ray which has 100-4000 Angstrom wavelength causes damage on the eyes of employees. In addition, due to the fact that that ray cannot be seen, it is impossible to protect the aid of the eye reflexes. Hands and face of workers should be protected to not be adversely impressed by rays emitted from welding or cutting. Otherwise, burning eye, bloodshot, and redness can be observed in employees. Such health problems may occur during welding and cutting in the acute (short-term). Due to resulting in long-term (chronic) eye disorders, employees in welding and cutting result in the loss of vision in varying proportions and permanent blindness disease. Depending on the wavelength of the radiation, it causes permanent damage such as blindness and cataract disease [1].

1.2.Investigation of the Effect on The Cornea Structure of The Ultraviolet

Ultraviolet (UV) keratitis is a self-limited, inflammatory condition can be lead to pain and temporary visual disturbance following acute UV radiation exposure [9]. Ultraviolet (UV) keratitis is relatively rapid in both onset and resolution. The clinical syndrome is characterized by onset of the significant ocular pain and decreased acuity between 6 and 12 hours after exposure to a welder's arc or a tanning lamp.

These rays are effective in the first and most corneas. A superficial punctuate keratitis, typically bilateral, develops early; in severe cases, this objective is frequently followed by total epithelial desquamation. Conjunctive chemosis, lacrimation, and blepharospasm are also usually present. Corneal reepithelialization, aided by lubrication, patching of the eye, or a bandage contact lens, occurs over a 36- to 72-hour period. Long-term sequelae are rare. This is in contradistinction to damage to the epithelium from certain chemicals (e.g., alkalis and strong acids) where re-epithelialization is often delayed or abnormal [10].

In this study, the 60 patients who have been exposed to the ultraviolet radiation in arc welding have been examined into changes in the structure of the cornea between 2012-2014 time periods. We studied patients admitted us in the remaining eye clinic and after exposure welding arcs.

2. Materials and Method

We retrospectively reviewed all cases of UV keratitis that occurred on welder's arc from 2012–2014. All procedures followed the Declaration of Helsinki rules and informed consent was obtained from the participants. The study was approved by the institutional ethic committee. Participants were recruited from Ophthalmology clinic at Adıyaman University Education and Research Hospital. Sixty patients were participated in the study. All patients underwent slit lamp examination. After being given a treatment kontrolera were performed. We used to show Sodium fluorescein corneal epithelial pathology. Patients pain, redness, we have recorded the punctate keratitis e conjunctivitis symptoms. Anterior segment images were evaluated. Changes in corneal epithelium were evaluated. Patients were examined whether or not to wear protective goggles.

3. Results

Fifty-four of the sixty patients were men and the others were female. with a mean age of 47.5±10.5 and 33,15±12,95 years (ranging from 18 to 75 years). 95% of the patients were also cause eye pain, it has been obtained eye redness in %5, punctuate keratitis in %100 of patients. 60% of patients would like to participate in the event conjunctivitis. Thirteen of the 42 (70%) cases occurred in participants who were not wearing protective glass. 18 cases (30 %) occurred in participants who were wearing protective glass.

Figure 3. Redness of the eye.

4. Discussion

The eyes must be also protected against infra-red (IR) and ultraviolet (UV) rays emitted from welding in addition to the chemical mechanical and thermal irritants. To that end, welding goggles and welding mask must be used against hot particles and radiation. Permeability of welding goggles depends on the quality of consisting ray.
The environment of the weld zone must be covered with opaque panels or curtains to protect welder from hazardous radiation. Panels must be made from portable materials. Thick canvas or ultraviolet (UV) absorbing plastic material should be used in accordance with this purpose. Yellow, green or orange panels should be chosen to reduction the reflections in plastic curtains and panels and the glare. However, curtains and panels should be kept away from fire in case plastic curtains or panels are used, and the airflow must not be obstructed.

Conclusion

Seems to be wearing goggles low rate in the working area. Patients to ophthalmologists refers to the most common eye pain complaints. Appropriate eye protection, including adequate glass with appropriate side shields, should be worn in work environments in order to prevent UV keratitis.

References

[1] Tan O, Effect on Work Area and the Health of the Employee in the Welding Manufacturing . (MSc) YTÜ. MYO; 2008.
[2] http://www.fizikanaliz.com/kaynakisleri.html. access date 25/03/2015. Access date 25/03/2015.
[3] Kaluç E. To National Organization in the Welding Technology Area. Welding Technology II. National Congress. Kocaeli University, Welding Technology Research, Education and Application Centre.

[4] Eryürek B. Gas Metal Arc Welding. AS Kaynak Yayını. 2006;52-80.
[5] Çelik S., Lecture Note Balıkesir University, Faculty of Engineering, Department of Mechanical Engineering.
[6] Handbook of welding techniques.
[7] Yılmaz F, Safety in welding. Gaziantep Üniversity, Faculty of Engineeering, Department of Mechanical Engineering.
[8] National aeronautics and space administration http://science.hq.nasa.gov/kids/imagers/ems/waves3.html. Access date 25/03/2015.
[9] Guercio B., Tabin G. MD Ultraviolet Keratitis Among Mountaineers and Outdoor Recreationalists. Scott E. McIntosh, MD, MPH[a], , Drew Leemond, Tod SchimelpfenigdWilderness & Environmental Medicine. 2011;22,2,144–147.
[10] Photo toxicity and the cornea. Schein OD1. J Natl Med Assoc. 1992 Jul;84(7):579-83.
[11] Yurtsever E., Özdemir G. Occupational Safety in Welding Technique Application' Cukurova University V. National Safety Congress /2009.
[12] Safety in Welding. Cutting and Allied Processes. ANSI Z49 1; 2005. An American National Standart.