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Original article

A prospective study of angle grinder injuries in the hands and forearms during a one-year period

Évaluation des lésions aux mains et aux avant-bras causées par une disqueuse: étude prospective durant un an

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ABSTRACT

Angle grinders are powerful tools used for cutting, shaving and polishing metal, stone, concrete and many hard surfaces in the work and hobby context. The aim of this study was to evaluate the acute hand injuries caused by angle grinders and to identify risk factors. Out of 742 acute hand and forearm injuries presenting in our emergency department between March 2016 and March 2017, 82 cases of injury due to angle grinder were included in the study. The age, gender, occupation, experience and education level of the injured patients were recorded. In addition, the location, mechanism, time of day, cigarette or alcohol use and occupational cases were determined. The Modified Hand Injury Severity Score (MHISS) was used to determine the injury severity. The vast majority of injuries (except 8) were not occupational injuries. They often occurred when individuals were using this tool outside of a work context (home, etc.); 44% of the patients were retired. There were more injuries between the hours of 3 pm and 6 pm. The mean overall MHISS score of was 74 (2–330). These angle grinder injuries, many of which are severe, are difficult to treat and the resulting disability is high. Many factors, such as smoking, age and time of day contribute to these injuries. Precautions should be taken and safety training should be provided for this powerful tool which is widely used and easy to obtain.

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R É S U M É

Une disqueuse (meuleuse d'angle) est un outil puissant utilisé pour couper, raser et polir le métal, la pierre, les surfaces bétonnées et dures au travail ou dans les loisirs. Le but de cette étude était d'évaluer les lésions causées par cet outil, qui sont fréquemment rencontrées parmi les lésions graves à la main et d'identifier leurs facteurs de risques. Parmi les 742 lésions graves à la main et à l'avant-bras admises au département des urgences et de la traumatologie entre mars 2016 et mars 2017, 82 cas causés par une disqueuse furent incluses dans le cadre de cette étude. L'information démographique de ces cas incluant l'âge, le sexe, le métier, l'expérience et le niveau d'éducation fut enregistrée. En plus, la localisation, le mécanisme, le temps, la consommation de tabac et d'alcool et les cas professionnels furent consignés en relation avec la lésion. Le *Modified Hand Injury Severity Score* (MHISS) fut utilisé pour évaluer la gravité de la lésion. La vaste majorité des lésions (excepté 8) n'ont pas été causées dans le milieu professionnel et beaucoup furent produites quand les individus étaient à l'extérieur du secteur de travail (maison, etc.) et 44 % des personnes étaient à la retraite (36). Un accroissement temporel des taux de lésion a été observé entre 15 h 00 et 18 h 00. Le score moyen MHISS obtenu de 82 patients était de 74 (2–330). Les lésions

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causées par une disqueuse sont difficiles à traiter et entraînent une grande incapacité. Plusieurs facteurs comme le tabagisme, l'âge et les facteurs temporels affectent la blessure. Des mesures préventives devraient être prises et une formation en sécurité devrait être prévue pour l'utilisation de ces outils qui sont largement utilisés et faciles à obtenir.

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1. Introduction

Hand injuries are now common in the emergency department (trauma admissions). They require acute and surgical interventions as well as long-term rehabilitation and have high disability rates [1]. In addition to occurring in a work context, they also occur frequently in all areas of life (sport injuries, home, public venues) [2]. The individual himself can cause this situation or can cause injuries leading to accidents [3,4]. When assessed over a wide spectrum, the injury involves disability, time away from work and high treatment cost [5]. Many of these injuries, which are both medically and economically burdensome, can be avoided. Several studies have focused on ways to prevent hand injuries [6–8].

Angle grinders are powerful hand tools with multiple uses in the workplace. Angle grinders have a high-speed disk that can cut, grind and polish metal, concrete and other hard surfaces [9]. With wider use, the number of injuries due to angle grinders has increased. Royal Society for the Prevention of Accidents Accident Surveillance Systems data showed that angle grinders are the most dangerous tools with an average of 5400 injuries recorded yearly. Although the most commonly injured area are the head and face, upper extremity injuries are also common [10–12].

In this study, the characteristics of hand and forearm injuries caused by angle grinders were defined and risk factors for this injury were determined.

2. Patients and methods

This prospective study was approved by the Ege University Local Ethics Committee (Approval no: 15-12.1/1). All patients were informed about their inclusion in the study and consent was obtained. Eighty-two cases of angle grinder injury out of 742 acute hand and forearm injuries seen at the emergency room of our hospital between the March 2016 and March 2017 were included in the study prospectively. The injured patients were evaluated by the on-call orthopedic surgeon who then filled out a questionnaire. Age, gender, occupation, years of work experience, level of education, health insurance and dominant hand information were recorded. In addition, the location, mechanism, time of day, cigarette or alcohol use, etiology, instrument type and occupational cases were also determined.

Anatomically, the injured region was divided into four regions: dorsal forearm, volar forearm, dorsal hand and volar hand. After the operation, the number and type of damaged structures (tendons, nerves, bundles, vessels, amputations) were recorded.

For occupational accidents, the patient was asked whether protective gloves were used continuously and whether they were being worn when the accident occurred. The time of the accident was recorded. The patients were asked about the training they had received on use of angle grinders.

The injury mechanism was categorized as glass punching, angle grinder, suicide, firearm, cutting tool attack, home accident, traffic accident, or other.

The Modified Hand Injury Severity Score (MHIS) was used to assess the severity of the injury [13]. In this scoring system, skin, skeletal, motor (tendons and muscles) and neurovascular structures were assessed individually and graded. Each injured structure was rated as absolute and weighted. Weighted factors were scored

specifically for the injured structure associated with the functional state. Open fractures, dirty wounds, crush injuries and avulsions are recorded as double score for that component. The MHIS score was calculated for each case and grouped as minor (MHIS < 20), moderate (MHIS 21–50), severe (MHIS 51–100), or major (MHIS > 101).

Statistical analysis was performed using SPSS version 21.0 (SPSS Inc., Chicago, Illinois, USA). Student's *t* test, ANOVA, variance analysis, Bonferroni corrections for the post-hoc tests and Pearson correlation analysis were performed. The significance level was set at 0.05.

3. Results

Eighty-two patients with angle grinder injuries were evaluated. The mean age of the patients was 42.3 (18–78) years. There were 23 patients with a right-sided injury, while 57 injuries were on the left side and 2 patients had bilateral injuries. The non-dominant extremity was more frequently injured (22 dominant, 58 non-dominant side, $P < 0.05$).

Of the 82 patients, 43 (52%) had primary school education, 30 (37%) had high school education and 8 (9%) were college graduates. In terms of occupation, 15 (18%) patients were actively working, 31 (37%) were retired and 36 (44%) were employed in other occupational groups. Seven patients (8%) were not covered by any health insurance scheme.

In all cases, the type of injury was a laceration by a sharp object; two patients had additional injuries other regions of the body (lower extremity).

When the experience and training levels of the patients were evaluated, none of them had received any specific job safety training related to the use of angle grinders. Twenty-two of the patients stated that they had read the instructions, while 28 said that they were informed about using protective gloves. Only three patients were using protective gloves at the time of the injury.

Eight of the cases were considered as occupational injuries. All patients said they had received job safety training but had not received special training on angle grinders. The remaining 74 cases were injuries that occurred outside the workplace. The majority of them occurred while doing small jobs around the house like cutting wood, polishing stone or iron, etc. The mean experience with this tool was 3.7 years. Twenty-three cases had < 1 year of experience, while 35 had 1–5 years, 16 had 6–10 years, 6 had 11–20 years and 2 had 20 years of angle grinder experience. There were no previous injuries of this type in any patient.

In terms timing during the day, the greatest numbers of injuries between 3 pm and 6 pm, with a peak at 5 pm. Since the number of occupational accidents was limited, a general distribution was provided (Fig. 1).

While 63 (76%) of the patients were smokers, the mean cigarette consumption rate was 17 per day. When total hand injuries were evaluated, the patients with angle grinder injuries were more likely to be smokers ($P = 0.028$). Thirty-two patients (39%) consumed alcohol in general while one patient had consumed alcohol before the injury. There was no significant difference between alcohol use and angle grinder injury ($P = 0.814$).

When the anatomical region and structures were evaluated, the most injured area were the dorsal aspect of the hand and finger

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