Safety of Play Equipment and Surfaces for Children in Playgrounds in Relation to Dental Trauma

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Abstract

Playgrounds provide a recreational refuge for children, away from traffic and other outdoor hazards. If applying standards can identify unsafe playgrounds and, more importantly, reduce the rate of child injury, such standards would be a useful tool for school and municipal authorities responsible for playgrounds. The aims of this paper are to review current standards and to evaluate compliance with these standards as far as the safety of play equipment and surfaces for children in playgrounds related to dental trauma is concerned. It is concluded that paediatric dentists and paediatricians should inform patients, guardians, and local authorities regarding guidelines for safe playgrounds.

Key Words: Dental Trauma, Playground Equipment, Playground Surface, Safety

Introduction

Playgrounds were originally developed during the 19th century to offer children play opportunities in an increasingly industrialised society [1]. They provide a recreational refuge for children, away from traffic and other outdoor hazards. In addition, playground activities can enhance children's cognitive, physical, and psychosocial skills. However, playground safety and the prevention of injuries in playgrounds are of concern to physicians, parents, and others. Between 2000 and 2004, playground and park area accidents were responsible for 3% of all body injuries to children in the European Union (E.U.) [2]. The findings of a Welsh study showed that 90% of all playground injuries that resulted in a visit to an accident and emergency department were related to the playground equipment [3].

To enhance the development of a child, playgrounds must, by definition, pose a challenge to the child. Therefore, using playground equipment will never be entirely without risk. The aim of standards pertaining to playgrounds should be to optimise child safety while balancing this with the need for provision of a challenging environment [4]. Standards for playgrounds have been developed both in E.U. [5,6] and internationally, in Canada [7], Australia [8], the U.S.A. [9], and New Zealand [10]. There are no E.U. regulations on playgrounds, but there are voluntary European standards dealing with the construction, installation and maintenance of playground equipment and impact-absorbing surfaces [11].

There are rare reports demonstrating that children have suffered dental trauma in playgrounds [12,13]. If standards can be identified and applied to unsafe playgrounds, it should be possible to reduce the rate of child injury. Such standards would be a useful tool for school and municipal authorities responsible for playgrounds.

Aim of this Review

The aims of this paper are therefore to review current standards and to evaluate compliance with these standards as far as the safety of play equipment and surfaces for children in playgrounds related to dental trauma is concerned.

Key Factors

The safety of children in public playgrounds is a complex interaction between several factors, including those relating to children. Recently, the

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height of equipment, and type and depth of surface have been identified as key factors in risk of injury to children from playground falls [14-17].

Child factors

For playgrounds intended to serve children of all ages, the layout of pathways and the landscaping of the playground should include distinct areas for the different age groups. The areas should be separated at least by a buffer zone, which could be designed as an area with shrubs or benches. This separation and buffer zone will reduce the chance of injury from older, more active children running through areas filled with younger children with generally slower movement and reaction times [18].

It is well known that the majority of dental injuries happen in children between ages of eight and eleven years [19]. These children should be informed regarding injuries, trained in first aid, and guided about whom they should contact in emergencies. Children under the age of six years, whose motor functions are not skilled enough, should be directly monitored by their parents or guardians. Furthermore, children with attention deficit hyperactivity disorder (ADHD) and disruptive behavioural disorders (violence) may bring extra risks of orofacial injury and should be kept under control [20]. Parents should make sure that children of all ages wear shoes when they are in playgrounds.

Critical fall height

Accidents to children in playgrounds have shown that the majority of the more serious cases were head injuries caused by striking hard ground [21]. If a child falls from an item of playground equipment, then (s)he falls subject to the forces of gravity. This acceleration throughout a 2500 mm fall will result in a fall speed of 7 m/s at the point of ground contact. The purpose of a safer surface in a playground is to absorb the impact of such a fall and to prevent a child suffering a head impact, which could be life threatening. The ability of a surface to absorb an impact is measured by its critical fall height [22]. Surfacing materials should be installed to a minimum depth relating to the critical fall height; 300 mm is recommended as the minimum depth where equipment higher than 600 mm is in place. Accuracy of critical fall height is difficult to determine. Children may fall from standing on the equipment or hanging by their arms from the equipment. Regarding the present situation, it is assumed that critical fall height is equal to the equipment height.

Type and depth of playground surfaces

Any installation above 600 mm in height should have impact-absorbent surfacing. If climbing is possible on and around the apparatus, then an impact-absorbent surface should extend outside the apparatus to a distance of 1800 mm from the out-

Table 1. *Examples of Surfacing Materials*

Material	Description	Minimum depth	Maximum free height of fall	Position
Bare earth	0.2-5 mm particle size	300 mm	3.0 m	Loose, cheap
Bark	20-80 mm particle size	300 mm	3.0 m	Loose, less expensive
Concrete/ asphalt	No particle size	-	-	Never recommended, health concerns, icy in cold
Grass	1-50 mm particle size	300 mm	3.0 m	Loose, natural, expensive, not recommended
Gravel	2-8 mm particle size	300 mm	3.0 m	Loose
Rubber matting	190-240 mm particle size	200 mm	3.0 m	Safe, not natural
Sand	0.2-2 mm particle size	300 mm	3.0 m	Safe, most widely used and appopriate. However, infections possible from animal faeces and there is a broken glass risk
Tree/woodchip	5-30 mm particle size	300 mm	3.0 m	Loose, good for humid regions. However, infections possible from animal faeces and there is a broken glass risk

side of the base of the apparatus [22]. If rotation around the apparatus is possible, for example on bars, then an impact-absorbent surface is necessary. Where apparatus is designed to cause a loss of balance, and such loss of balance can occur, then impact-absorbent surfacing should be planned regardless of height. Impact-absorbent surfacing (safer surfacing) can be provided in a variety of materials, secured or loose *(Table 1).* Play bark should be dug over regularly and the base surface checked for composting. The bark will need "topping up" to maintain its impact absorbency. Children are generally not protected against arm fractures by bark surfaces. It has been suggested that a rubberised impact-absorbing surface is safer than bark [3]. Rubber is generally recommended; however, it should be noted that it is not natural and no electricity flow occurs through the body of the child. Although sand is referred as loose, an Australian study found that children were more likely to be injured on a rubber-matting playground surface and less likely to be injured on sand [23]. Wood chips can be practical for Nordic countries and North America, where rain and humidity are persistent, meaning that wood chips expand and become more absorbent *(Figure 1).* Another health concern with regard to dirty sand, bark, and gravel is that pets may urinate or defecate on these surfaces. This can lead to infections, which may be severe and in the case of tetanus may be fatal [24]. Thus, in cases of intra-oral wounds, tetanus prophylaxis and vaccination should be considered.

In Turkey, playgrounds were recently evaluated in a number of studies regarding child trauma prevention. In Isparta, it was found that 80.7% of the playgrounds surveyed lacked adequate protective surfacing [25] and in Elazig, the ratio of unacceptable playground surfaces was 87.5% [26]. It is most important that all clinicians who have to deal with trauma to children should be aware of the risks of playground injury in the cities and areas where they practise. In an observational example, in Kadikoy, Istanbul, it was found that in 2009, 32.9% of all playgrounds used rubber matting whereas 67.1% used sand to cover surfaces. A study performed in a Montreal public playground [27] and another study conducted by the Consumer Federation of America and U.S. Public Interest Research Group [28] established that 75% of the playgrounds surveyed in study areas lacked adequate protective surfacing.

Figure 1. *Wood chip/gravel mix playground surface and wooden ladders are preferred (Istanbul, Turkey).*

However, surface types cannot be considered in isolation from equipment. When exposure is taken into account, the risks to children receiving injuries on different pieces of equipment differ.

Play equipment design and height

Generally, long, low designs are preferable to those where height is the dominant feature. Apparatus should be designed to offer safe escape systems and routes. The essential design consideration is the space in and around each individual item of equipment: the minimum use zone. This is calculated by taking into account the space occupied by the apparatus and the area of its operation, together with an allowance for free movement of children. It is recommended that 1800 mm is the minimum distance [10]. This space should not overlap between two pieces of apparatus. No reduction to this standard is acceptable.

Guidelines for specific items of playground equipment include the following.

Horizontal ladders and track rides

The height of horizontal ladder and track ride equipment needs to be greater than 1500 mm to allow for effective use and less than 2000 mm to reduce injury [23]. A compromise height of 1800 mm for horizontal ladders and track rides is recommended. In recent studies in Australia and New Zealand, a large proportion of body injuries were stated to result from falls from overhead horizontal ladders [23,29]. In general, these items should not be provided in playgrounds [18]. However, with regard to the cognitive development of the child, more protective wood track rides may be useful.

Monkey bars

The probability of receiving an injury when playing on monkey bars is twice that of a climbing frame

and seven times that of a swing or slide. Therefore monkey bars are identified as having an especially high risk, probably because of the upper-body strength and coordination they require. It has therefore been suggested that they should not be provided in playgrounds [5]. Furthermore, a recent study found that monkey bars or upper body devices were the most common cause of all childhood extremity fractures [30].

Slides

Slides are recommended; however, they should not be free standing [21] *(Figure 2).* Slides are best located in an uncongested area of the playground, should have a smooth sliding surface without roughness, a waiting platform with a security fence around the top platform, a landing section parallel to the ground, and a maximum height of less than 1800 mm [18].

Swings

Parent/guardian supervision of children aged under six years is obligatory. It should be noted that swings are listed in the top ten of play and leisure activity products involved in injuries [2]. Swings should incorporate a protective bar and safe entries and exits to the area in which they are located [18].

Teeterboards

No injury, or statements have been reported in the literature with regard to teeterboards; however, when they are used, parent/guardian supervision of those aged under six years is obligatory.

Equipment not recommended

Some playground equipment is not recommended for use on public playgrounds, including:

Figure 2. *Children under six years of age should be directly monitored by their parents or guardians. Note rubber matting surface (Istanbul, Turkey).*

1. Trampolines, swinging gates, giant strides, climbing ropes that are not secured at both ends, heavy metal swings (e.g., animal figures). These are not recommended because their heavy rigid metal framework presents a risk of impact injury [18].
2. Multiple occupancy swings (with the exception of rubber tyre swings) that are intended for more than one user. These are not recommended because their greater mass, as compared to single occupancy swings, presents a risk of impact injury *(Figure 3a, b).*
3. Rope swings. Free-swinging ropes that may fray or otherwise form a loop are not recommended because they present a potential strangulation hazard.

Summary

What this paper suggests:

- That standards in all countries would be a useful tool for school and municipal authorities responsible for playgrounds.

Figure 3 a, b. *This new moving equipment (multi-user swing) should be monitored and established in a buffered zone for 6-12-year-olds. Multi-players should be avoided (Tallinn, Estonia).*

- Removing and replacing unsafe, broken, and hazardous playground equipment and loose surfaces are effective strategies for preventing playground injuries.
- Horizontal ladders, track ride equipment, and monkey bars should not be recommended.
- Long, low elements are preferable to those where height is the dominant feature regarding critical fall height.
- That the playgrounds should be designated according to age appropriateness.
- Children aged under six years of age should be directly monitored by their parents or guardians.

Why this paper is important to paediatric dentists:

- Practitioners should inform patients and guardians, and should play an active part in the provision of appropriate playgrounds by lobbying their local councillors.
- It is suggested that practitioners should produce material for information boards that displays details of what to do in a case of dental trauma and this should be provided in public playgrounds.

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