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Review

Prevention of Sports-related Dental Injuries in Children

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Abstract：A sports-related dental injury is defined as injuries to the oral and maxillofacial regions associated with sports activities, and involves tooth fracture and luxation, facial bone and temporomandibular fractures, and soft tissue injury. Participants in sports activities are always at risk for traumatic injury, with the oral and maxillofacial region often affected. Dental injuries also have a high rate of occurrence among sports-related injuries received during school physical education classes and club activities. Unfortunately, nearly all such dental injuries are irreversible, and the loss of teeth or their supporting tissues has a significant impact on the quality of life of affected individuals. Thus, for prevention of sports-related dental injuries, it is important for dental professionals to disseminate correct knowledge regarding oral health, as well as provide information to reduce and treat risk factors such as dental caries, periodontal disease, and occlusal problems. In particular, use of mouthguard is one of the most effective ways to prevent sports-related dental injuries that occur in sports and physical activity participants. Recently, along with increased health consciousness, the number of individuals who participate in sports and fitness activities is also increasing. Outside of the bounds of conventional dental clinical treatment, dentists are encouraged to actively be involved in local and regional organizations related to sports, recreation, and physical activity opportunities, in order to contribute to promotion of safety and health, including injury prevention. In this review, we discuss various findings to prevention of sports-related dental injuries in children.

Introduction

Physical activity plays an important role in the growth and development of children, with multiple benefits for both physical and mental health. The World Health Organization recommends physical activity for prevention of non-communicable diseases and promotion of general health by dividing individuals into 3 age groups; 5-17, 18-64, and 65 years old and above[1)]. In particular, the guidelines recommend that children and youth aged from 5-17 years should have at least 60 minutes of moderate to vigorous intensity physical activity each day, which is based on scientific evidence[1)]. The government of Japan has also promoted "Healthy Japan 21" as the premier preventive policy of lifestyle-related diseases since 2000 and recommends daily physical activity for all generations, including children[2)]. In 2012, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan proposed a basic sports participation plan including increased opportunities for sports participation by children,

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as well as improvements in sports environments in order to sustain and stabilize an upward trend in the physical strength of youth[3]. Thus, to resolve problems associated with lifestyle diseases, it is especially important that children engage in physical activity as part of a healthy lifestyle, as that is a highly effective approach for improving ones own health.

On the other hand, physical activities and sports participation, especially vigorous activities and contact sports, have risk of injury, which is defined as damage leading to loss of a bodily function or structure that is apparent in clinical examination findings[4]. Although sports-related injuries are often unavoidable by the participants, many can be prevented by taking appropriate measures. Encouraging children to participate in sports is certainly worthwhile, while it is also essential to provide measures for prevention of sports injuries.

Incidence of sports injuries

The oral and maxillofacial regions are the main areas affected by traumatic injury, which can occur as a result of a fall, traffic accident, fighting, and sports participation. The most common cause of dental injuries in preschool children is a fall, while sports participation and being struck by another person are common in school-age children[5]. As for adolescents and young adults, the most common etiologic factors of dental injuries are injuries that occur during sports activities, traffic accidents, or some form of violence[5-7]. Oral injuries occur most frequently during the first decade of life and then gradually decrease with age[5, 8]. As for traumatic dental injuries in children, those related to sports participation or physical activities are most common. In the United States, approximately 30 million children participate in organized sports programs[9] and it has been found that 10-39% of traumatic dental injuries in children are related to sports activities[10]. In Japan, 90.1% of boys and 68.7% of girls aged 12-14 years, and 70.2% of boys and 45.4% of girls aged 15-17 years participate in organized sports programs[11] and the Japan Sport Council reported that 45.4% of junior high school students and 52.8% of high school students have experienced some kind of injury during activities performed outside of school[12]. In addition, a cross-sectional study of young Japanese athletes revealed that the prevalence of sports-related dental injuries was 13.3% of total injuries, with those occurring 1.5 times more often in males[13]. Contact (e.g., handball, basketball, wrestling) and limited-contact (e.g., softball, baseball) sports present a significantly higher risk of dental injury as compared to non-contact sports (e.g., volleyball, badminton, tennis)[12]. Among junior high school boys, softball is the sport most frequently related to dental injury, whereas Japanese-style wrestling and rugby are most commonly related to such injury occurring in high school boys[12]. In children aged 7 to 12 years old, baseball participation was found to have the highest risk for dental injury, while handball for girls and basketball for both genders were the most common sports related to dental injuries in the 13- to 17-year-old age group[12, 14, 15]. On the other hand, sports-related dental injuries frequently occur even during participation in non-contact sports, such as volleyball, due to collision with a teammate, or the face striking equipment used for the sport or the floor. For prevention, it is important to first understand that sports-related dental injuries can occur in every sport as well as the mechanical forces that can lead to injury in each particular activity.

Classification of dental injuries

Sports-related dental injuries are the most common type of orofacial injury related to sports participation and became recognized as a public dental health problem in the 1980s[16]. Traumatic dental injuries include tooth fracture (broken teeth) and luxation (displaced, lost teeth), as well as facial bone and temporomandibular fractures, each of which has significant effects on oral functions such as chewing and speech. Traumatic dental injuries can also cause damage to adjacent gums, lips, and soft tissues in the facial area. In addition to physical and structural problems, the psychosocial development of affected individuals can also be influenced because of aesthetic and functional concerns[17, 18]. Sports-related dental injuries are a major oral health problem in children, as they have both immediate and long-term emotional and social impact, and may require emergency dental care and long-term treatment, thus making dental care costly[19, 20].

Representative Cases

Case 1: Crown fracture with pulp exposure and extrusion

A 15-year-old boy suffered a horizontal crown fracture of the maxillary right lateral incisor and forced displacement of the maxillary right central incisor after falling while riding a bicycle. In addition to the fractured tooth, the enamel was damaged, and dentin and pulp were exposed. Calcium hydrate was applied to the amputated surface of vital pulp and the fractured tooth fragment was adhered, then the displaced tooth was reset in its original position and fixed (Fig. 1).

Case 2: Tooth avulsion and lateral luxation

An 11-year-old boy suffered from avulsion of the maxillary left central incisor and forced displacement of the maxillary right central incisor after a fall while running. The avulsed tooth was replanted into the original alveolar socket and the displaced tooth was reset in its original position, then both teeth were fixed (Fig. 2).

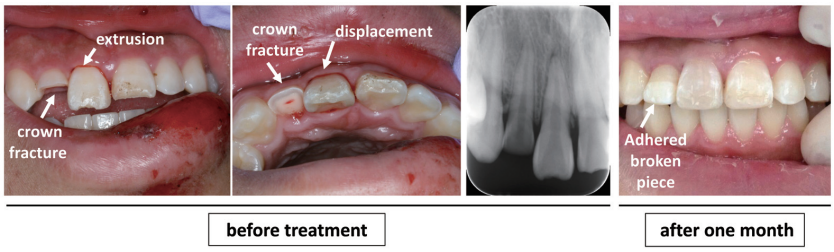

Fig. 1 Case 1

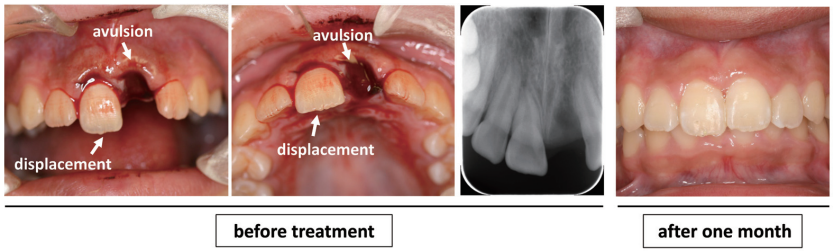

Fig. 2 Case 2

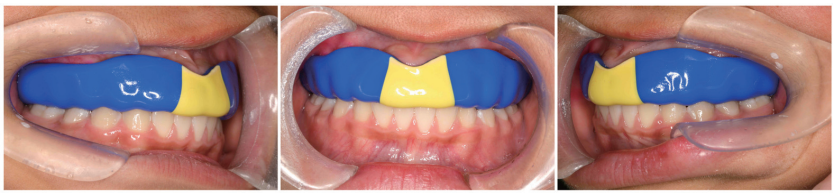

Fig. 3 Sample custom-made mouthguard

Prevention of sports related dental injuries

The majority of sports-related dental injuries occur in regions including the upper lip, upper jaw, and maxillary incisors[15] with the primary cause direct external force due to a fall, collision with sports equipment, or player-to-player contact. Many such dental injuries are irreversible and their probability of occurrence is constant. Thus, it is necessary to carefully consider this situation and take appropriate preventive measures.

Increased overjet (>3.0 mm) and inadequate lip coverage are risk factors for dental trauma in children[21, 22], and it has been suggested that preventive orthodontic treatment for patients with an overjet greater than 3 mm reduces the risk of dental trauma[15, 22]. Thus, the occlusal relationship of teeth should be considered as a risk factor for sports-related dental injury occurrence.

The presence of oral diseases, such as dental caries and periodontal disease, is also a risk factor for dental injuries related to sports participation, with dental caries a possible cause of tooth fracture and periodontal disease a cause of tooth luxation. Poor oral health has been found to be a common problem among elite athletes[23]. Oral disease that causes pain, systematic inflammation, and/or has a psychosocial impact can directly influence individual sports performance, and may be a factor leading to sports-related injury occurrence[23]. In addition, sports drinks, which typically have high sugar and strong acidic contents, are frequently ingested during sports activities, and a high frequency of such consumption was shown to be strongly associated with development of dental caries[24]. In addition, the pro-inflammatory effects of high carbohydrate intake are also correlated with increased risk of periodontal disease[25]. Thus, it is clear that inappropriate consumption of sports drinks can have a negative effect on oral health.

Although it is important to treat and prevent oral diseases such as dental caries and periodontal disease in light of reducing the incidence of sports-related dental injuries, use of a mouthguard is considered to be the most effective method. A proper mouthguard protects the teeth, lips, gingiva, tongue, and mucosa, and can decrease the risk of sports-related dental injuries. The device should be constructed in such a manner to protect the lips and intraoral tissues from bruising

and laceration, prevent tooth injuries such as crown and root fractures, and luxation, and provide support for edentulous space[15, 26]. Furthermore, a mouthguard can also help cushion blows that cause jaw fractures and temporomandibular joint trauma[27].

Mouthguard prototypes were originally developed to protect boxers from lip lacerations and typically made from sponge, cotton, tape, or small pieces of wood[28]. In fact, mouthguard use as a protect device for sports-related dental injuries has a history of more than 100 years. Currently, mouthguards are mandatory for a variety of sports, including boxing, kickboxing, American football, rugby, lacrosse, inline hockey, ice hockey, and karate, while the Japanese Society of Pediatric Dentistry has recommend their use in 30 specific sports activities (taekwondo, kung-fu, wrestling, soccer, basketball, volleyball, handball, field hockey, baseball, softball, motor sports, squash, water polo, gymnastics, weight lifting, skateboarding, skiing, equestrian events, bicycle racing, surfing, shot put, acrobatics, racquetball, inline skating, martial arts, bandy, skydiving, judo, sumo).

An ideal mouthguard should be protective, comfortable, resilient, resistant to tearing, odorless, tasteless, inexpensive, easy to fabricate, and not interfere with speech[10, 29]. There are three basic types; pre-made, mouth-formed, and custom-made. A pre-made mouthguard, also known as a stock mouthguard, is designed for use without modification, thus it does not always fit an individual dental arch and is considered to have an extremely limited effect for protection from dental injuries. The mouth-formed type, also called a boil-and-bite mouthguard, is shaped after warming in hot water by placing in the mouth of the user, who provides biting pressure. Although relatively easy to adjust, this type may be worn in an incorrect dental occlusal position or can feel bulky in the mouth. On the other hand, a custom-made mouthguard (Fig. 3) designed by a dentist is highly recommended in regard to the above conditions and best for providing protection from sports-related dental injuries. The American Dental Association has estimated that approximately 200,000 orofacial injuries that occur in football players each year would be prevented by the use of faceguards and mouthguards[27]. It is important for the dental profession to inform and educate sports participants regarding the risks of sport-related dental injuries, and also provide effective prevention measures.

Conclusion

Participation in physical activities is vital for growth and mental health of children. Furthermore, physical activity such as sports participation is also recommended for all ages to prevent onset of lifestyle diseases and promote health. Therefore, increasing the awareness of sport-related injuries by providing prevention strategies is important for the dental field. We recommend that dental professionals maintain their awareness of these issues, and take a central role in informing children, parents, and coaches regarding the possibility of sports-related dental injuries as well as their prevention.

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