ERGOGENIC SUBSTANCE ABUSE BY ADOLESCENT ATHLETES: PERSPECTIVES FOR DENTAL PRACTITIONERS

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Introduction

Newspaper headlines and television breaking news reports abound with alarming evidence of the increasing misuse and abuse of performance enhancing **(ergogenic)** substances by today's athletes. This crisis is neither confined to professional sports figures nor to international world-class amateur athletes, but has expanded to include collegiate, high school, and even middle school students, both males and females.[1-5] Youngsters are participating at earlier ages in increasingly competitive sports; and often multiple sports simultaneously.[6] One overarching factor in today's sports equation is the allure of societal incentives and rewards for personal athletic success.

In addition to the potential for future fame and fortune, several other reasons have been postulated for the initiation of performance enhancing substance abuse patterns by adolescent athletes.[6,7] These include, among others, emulation of their favorite professional sports stars, improving personal strength and body build, gaining a competitive edge against opponents, or succumbing to peer-pressure.[8,9] But regardless the reason, such practices are illegal, unethical, and unhealthful placing these young athletes at increased risks for acute or chronic adverse systemic health outcomes.[10]

As current widespread abuse patterns continue to expand, it becomes even more critical for practicing dental professionals to be knowledgeable about the performance enhancing substance history of their adolescent athlete-patients.[11] An understanding of the effects and side effects of these substances will not only better prepare practitioners

with information to advise their adolescent athlete-patients more effectively, but also may enable the dental team to reduce the associated risks for adverse systemic outcomes during or after dental treatment. It is the intent of this article to provide an overview to practicing dentists of the adverse outcomes associated with the abuse of performance enhancing substances by their patients who are adolescent athletes, with particular emphasis on **anabolic-androgenic steroids.**

Doping

Using ergogenic chemicals or substances to boost athletic performance is known as **doping** and usually refers to those substances that have been banned by sports governing bodies. The 2007 Prohibited List published by the World Anti-Doping Agency is an international standard code that identifies substances and methods prohibited in competition, out-of-competition, and in particular sports.[12] Substances and methods are classified by categories. The use of prohibited substances by an athlete is a violation of the code; however, the code does provide a therapeutic use exemption for identified medical reasons. Readers interested in detailed information regarding the international standard may wish to visit the World Anti-Doping Agency web site at http://www.wada-ama.org/en/prohibitedlist.ch2

Performance Enhancing Substances: Selective Categories

A brief review of some of the major categories of banned performance enhancing substances seems warranted prior to undertaking a more detailed review of anabolic-

androgenic steroids. These selected categories include the following: **beta blockers, diuretics, stimulants, narcotics, growth hormones, and blood doping.**

Beta Blockers

Drugs such as atenolol, metoprolol, and propanolol are used to slow heartbeat and reduce tremors. The calming effects produced by beta blockers have been used illicitly by participants in shooting sports such as archery and rifle events, as well as in fencing. Beta blockers slow cardiac response time, make running difficult, and increase skin sensitivity to sun and temperature extremes. [4, 6-7, 12-16]

Diuretics

Drugs such as acetazolamide, hydrochlorothiazide, and triamterene are used to increase urine flow and volume. Increased urinary output produced by diuretics has been use illicitly by athletes in weight limit sports such as boxing and wrestling, as well as by participants in ballet, cheerleading, and gymnastics. Diuretics contribute to rapid weight loss, dehydration, ionic imbalance, and exhaustion. [4, 6-7, 11-16]

Stimulants

Drugs such as amphetamine, methamphetamine, pseudoephedrine, and albuterol are used to increase metabolic activity to reduce fatigue and enhance endurance. The effects of increasing alertness and improving reaction times produced by stimulants have been used illicitly by baseball players, skiers, and soccer players. Stimulants increase heart rate, blood pressure, nervousness, and irritability. They alter cardiovascular cooling and predispose athletes to heat exhaustion. [2, 4, 6-7, 11-12, 14-16]

Other stimulants of concern include smokeless tobacco and cocaine. Increased salivary flow and the nicotine buzz associated with smokeless tobacco are factors for its traditional use in baseball. In addition, athletes in weight category sports such as wrestling use smokeless tobacco as an appetite suppressant. Dentists should be alert to any intraoral soft tissue changes for possible biopsy of leukoplakia or excision and follow-up management of oral carcinoma in their adolescent athlete-patients who dip snuff. [17, 18]

The intense euphoria produced by cocaine reinforces its habitual use. In addition to perceived performance enhancement the abuse of cocaine by professional basketball and football players often has become a part of the persona and lifestyle of addicted athletes. Sudden deaths due to cardiac arrhythmias have been reported. Cocaine users, therefore, are of particular concern to dentists because of the potential for dangerous interactions that may result from the injection of local anesthetics that contain epinephrine. [4, 6-7, 12, 15]

Narcotics

Drugs such as heroin, hydrocodone, methadone, and morphine are used to mask pain. The analgesic effects produced by narcotics have been used illicitly by boxers, football players, and participants in the martial arts. Consequences associated with pain masking include overuse injuries or more serious traumatic brain damage. The addiction to narcotics also should alert the dentist to the ever-present and life-threatening dangers of drug overdosing. [4, 6-7, 11-12, 14-15]

Growth Hormones

Human growth hormone (hGH), human chorionic gonadotropin (hCG), and adrenocorticotropic hormone (ACTH) elevate testosterone in men and decrease fat mass. The effects of increased muscle mass and strength enhancement produced by these hormones have been used illicitly by athletes in baseball, swimming, and track and field. Misuse of hGH and hCG can cause fatal neurological disorders and misuse of ACTH may cause enlargement of the heart muscles. [2, 4, 6, 11-12, 13-16]

Blood Doping

Exogenous erythropoietin (EPO), autologous blood transfusions, and homologous blood transfusions elevate the hematocrit and hemoglobin concentrations in the circulating blood to boost the level of oxygen delivered to muscles and enhance aerobic endurance. Blood doping techniques have been used illicitly by athletes in cycling, skiing, swimming, tennis, and track. EPO increases red blood cell concentration and blood viscosity similar to polycythemia. These athletes are subject to higher sweating rates and increased risk for dehydration during competition. High concentrations of red blood cells could lead to clot formation, stroke, hypertension, and congestive heart failure. The misuse of blood transfusions increases the risk for transmission of blood-borne pathogens such as HBV and HIV infections. [4, 6, 11-13, 15]

Anabolic-Androgenic Steroids

Anabolic-Androgenic Steroids (AAS) are synthetic derivatives of the male sex hormone, testosterone. AAS build muscle tissue and body mass; increase strength and aggression. Users include body builders and weight lifters, track and field athletes and professional athletes in sports such as baseball, football and wrestling. Users refer to

AAS by various names such as ‘roids, juice, hype or pump. Adolescents, in their quest for status through athletic success, place themselves at increased risks for acute and chronic adverse systemic episodes by illegally and unethically misusing AAS. [2, 10, 14, 19]

AAS: Scope of the Problem

The illegal use of AAS by U.S. athletes has been reported to range from 1 – 3 million individuals. Perhaps even more alarming are the estimates of steroid use by high school students ranging from 4% to 11% for boys, and up to 3.3% for girls. Other studies have documented childhood steroid use at 2% to 3% for students from 9 years of age to young teens. Admittedly, while the incidence of AAS use by athletes of all ages represents a serious health risk for the individual, the extent of the problem represents an enormous and escalating public health issue. [1, 2, 3, 5, 14]

AAS: Routes of Administration

AAS are prepared in three forms based on the route of administration and include the oral route, the injection route, and the newer transdermal route. [2] Oral preparations must undergo hepatic conversion into testosterone to activate the drug’s effects. Oral AAS are short acting and eliminated over several days. Injectable steroids are more potent and consequently more dangerous than the oral preparations. Injectable steroids do not require hepatic conversion and have a longer-lasting effect than do the oral preparations. Users of injectable steroids are more likely to be identified through positive drug testing as these substances remain detectable for months after administration.[2, 10, 14] Transdermal delivery recently has become available. The steroid cream may be rubbed gently on the skin or a transdermal patch may be applied.

Generally, athletes tend to use AAS in the off-season during conditioning and strength training sessions. This is due in part to the decreased risk of being detected. AAS are used in cycles lasting 4- to 12- weeks. Taking multiple steroids at one time is referred to as **stacking** and the term **pyramiding** is used for a dosing schedule in which the highest amounts are taken during the middle of cycles. [2, 14]

AAS: Desired Effects

Athletes who succumb to the allure of AAS are seeking substantial gains in muscular strength and fat-free muscle mass. Strength enhancement has been recorded for both isokenetic and isometric strength. Gains in muscle mass have been attributed to muscle hypertrophy as well as to the formation of new muscle fibers. AAS have not been documented to enhance aerobic effects. [2, 14, 19]

AAS: Adverse Effects

Despite the gains in muscle mass (anabolic effect) and strength associated with AAS, the misuse and abuse of these performance enhancing substances is not without substantial risks to the health and well being of the athlete. While some of the adverse effects of AAS are reversible, others are not. These substances have the potential for devastating and life-threatening adverse effects on multiple systems, including deleterious effects on the **cardiovascular, musculoskeletal, genitourinary, hepatobiliary, dermatologic, and psychological** functioning of the user-athlete.

The negative **cardiovascular** effects of AAS include reversible elevations in blood pressure and total cholesterol, as well as reduction in high density (good) lipoprotein levels. Electrolyte disturbances, coagulation disorders, and cardiac dysrhythmias are potential adverse side effects. AAS increase the risk for cardiovascular

diseases such arteriosclerotic heart disease and cardiomyopathy. Acute thrombosis, myocardial infarction and, stroke also have been reported.[2, 10, 14-16, 19]

Although one of the desired effects of AAS is to increase muscle strength, the correlative negative effect is the increased frequency of **musculoskeletal** injuries. Often these are tendon sprains based on muscle strength gains that exceed the related strength of the tendon. An irreversible effect of AAS is that continued use may stunt linear growth by premature epiphyseal closure in skeletally immature individuals. [2, 10, 14-16, 19]

The adverse effects of AAS on **genitourinary** function are multiple. Males may actually experience a decrease in the production of endogenous testosterone as well as decreased size and firmness of the testes with fluctuations in sex drive. Gynecomastia in males is another associated condition. Female user-athletes gradually develop masculine secondary sexual characteristics (androgenic effects) that appear to be non-reversible such as deepening voice and clitoromegaly. Reversible negative effects in females include menstrual irregularity or cessation, and increased libido. [2, 10, 14-16, 19]

From the perspective of **hepatobiliary** function, AAS precipitate transient increases in liver function such as elevation in liver enzymes and bilirubin. There is an increased risk for liver tumors both benign and malignant. Blood-filled cysts (peliosis hepatis) are subject to traumatic rupture that may result in fatal hemorrhage. Sharing of needles for the injection route of administration of AAS has the potential to be the port of entry for Hepatitis B and HIV infectious diseases. [2, 10, 14, 16, 19]

Dermatologic problems encountered by male users of AAS include severe acne on the face and back as well as male-pattern hair loss on the scalp. Female users also

encounter increased acne in addition to skin coarseness and increased facial and body hair. [10, 14, 16, 19]

The adverse **psychological** effects of AAS are many and often unpredictable. While some may view increased aggression as a positive factor in the athlete's approach to training and competition, the risks include increases in anti-social "roid rage" behaviors such as fighting or destroying property. Severe mood swings fluctuate from anger, hostility, and irritability to anxiety with panic attacks or depression with thoughts of suicide. Hypomania, schizophrenia and psychotic episodes have been reported. Users may succumb to physical and psychological dependence to AAS. [2, 10, 14, 16, 19]

AAS: Dental Considerations

The key factor in providing safe and effective dental treatment to athletes who illicitly use AAS is a thorough understanding of the actions, interactions, and adverse effects that can result from the abuse of these performance enhancing substances. It is worth noting, however, that patients may not readily divulge their use of these substances or recognize the dentist's need to know. These patients are particularly vulnerable in the dental situation.

For those patients who do admit to using AAS it becomes incumbent upon the dentist to be prepared to question and interpret patient self-reported information and to integrate that information with the known adverse effects as outlined above to formulate a safe and effective dental treatment plan. It should be noted from the perspective of evidence-based scientific literature, that there is a paucity of information available on this topic.

The oral examination for athletes on AAS should include a thorough evaluation of the gingival tissues. A recent study identified significant levels of gingival enlargement in a group of body builders and weight lifters who used AAS on a prolonged basis. [20] While there were no statistical differences for scores on either plaque or gingival indices between the study group of users and the control group of non-users, AAS users did demonstrate statistically higher scores for gingival thickness, extent of gingival encroachment, and total gingival enlargement scores compared to the non-user control group. [20]

Other possible oral manifestations that may be associated with AAS abuse have been suggested. These include xerostomia, cervical decay, susceptibility to oral candidiasis, and trigger bruxism leading to TMD. [21]

The potential complications that might arise in the dental office for athletes on AAS require a cautious preparatory approach prior to the administration of local anesthetics and the initiation of oral surgical procedures.[21, 22] The most significant concern related to procedures such as third molar extractions or surgical placement of dental implants in patients on AAS is the potential for coagulopathy. [23] A complete blood cell count including a differential count and a platelet count should be ordered to identify polycythemia and thrombocytopenia. A prothrombin time also should be ordered to determine any deficiencies in the various clotting factors. Although these blood studies will identify potential coagulopathy risks and pre-surgical therapy can be directed toward correction of these problems, [23] there remains the potential for slow healing of the soft tissues at the surgical site. [21]

A further complication that may arise during surgical procedures is shock in those AAS abusers with suppressed adrenal gland function. [21] In some instances it may be advisable to recommend a delay in the surgery until after the AAS use has been discontinued and a sufficient period of time has elapsed to clear the system.

While the primary focus of this report has centered on the adverse side effects of performance enhancing substances as well as the implications for providing safe and effective dental treatment to user-athletes, dentists also need to be aware of several cautions to avoid inadvertently causing a positive drug test in their athlete-patients related to medications that we might administer or prescribe in the routine course of dental treatment.[22] For example, local anesthetics containing epinephrine should be avoided immediately prior to or during competition.[22] Prescribing post-operative opioid analgesics should be avoided in favor of non-steroidal anti-inflammatory medications.[22] The use of dental medicaments that contain corticosteroids for the treatment of oral ulcerations or for sedative dressings should not be prescribed. [22]

AAS: Legal Considerations

The acquisition of AAS and other banned performance enhancing substances for other than prescribe medical conditions is an illegal act and the use of these substances is unethical behavior in athletics. A conviction for the illegal possession of AAS is punishable by a minimum fine of $1,000 and/or a one-year prison term. A conviction for selling or the intent to sell AAS carries with it a fine of $25,000 and/or sentence of 5-years in prison. [2] The win at all cost attitude and achievement of personal athletic success, while viewed by many as motivational, may, conversely, promote unethical behaviors and illegal use of performance enhancing substances such as AAS by an

increasingly broad spectrum of athletes from professional and world-class amateur athletes down to impressionable pre-teenage youth, regardless of gender.

Final Considerations

The purpose of this article was to provide practicing dentists with an overview of information related to the adverse outcomes associated with the abuse of performance enhancing substances, with emphasis on anabolic-androgenic steroids by their patients who are adolescent athletes. Knowledgeable dentists are in a unique position to observe clinical signs of potential substance abuse and to ask their adolescent athlete-patients appropriate questions, in a non-judgmental manner, regarding their use of performance enhancing substances. Educational materials identifying the serious and life threatening side effects associated with the abuse of these substances can be provided to enhance the awareness of athletes. Appropriate guidance and referrals can be made for those who elect to make a quit attempt.

Drug testing of adolescent athletes remains a controversial issue. While the issue of drug testing is beyond the scope of this article, suffice it to say that rules and drug testing alone cannot resolve the problem of performance enhancing substance abuse by adolescent athletes. Education is one fundamental ingredient to facilitate interventions for both individual and public health strategies. It seems evident that dental practitioners, as health care providers have a professional responsibility to be prepared to address the various clinical challenges presented by today's adolescent athletes.[24]

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