Journal of Oral Science, Vol. 50, No. 1, 19-24, 2008

Original

Effects of use of anabolic steroids on the masticatory system: a pilot study

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(Received 17 May and accepted 7 December 2007)

Abstract: The use of androgenic anabolic steroids (AAS) has increased significantly among athletes in Brazil and other countries. These drugs alter the physiological behavior of bone and muscles, also affecting these structures in masticatory system. This paper aims to evaluate bone and dental changes in users of AAS, as well as the incidence of temporomandibular dysfunction (TMD), compared to athletes not using AAS. Eight athletes were equally divided in two groups, AAS users and non-users. The groups were evaluated using Helkimo index, McNamara cephalometric tracing and cast analysis. The AAS users presented more intense TMD signs and symptoms (Di total value, *P* = 0.096, Mann-Whitney test), increased cephalometric measures (Co-A, *P* = 0.020, Mann-Whitney test) and Angle Class II malocclusion, compared to the non-users. These results suggested that the use of AAS alters masticatory structures and increases the incidence of TMD. (J. Oral Sci. 50, 19-24, 2008)

Keywords: temporomandibular dysfunction; anabolic steroids; masticatory muscles; temporomandibular joint.

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Introduction

The use of medicines which help professional and amateur athletes improve their physical performance and body shape has attracted media attention. Androgenic anabolic steroids (AAS) top the list of drugs in positive anti-doping tests, with 39.3% of the total positive results (1).

The therapeutic indications of AAS include growth pathologic alterations, osteoporosis, treatment of mammary carcinoma and anemia (2). These drugs can also be used as secondary medicines for nutritional deficiency and fibrinolytic pathologies (3). In Brazil, even though epidemiological research on the use of AAS is lacking, it can be affirmed that its consumption has grown significantly among the young population. Brazilian health authorities have not been able to control its use mainly because there are no adequate laws regulating the sale of this kind of medicine. The main attraction of AAS is that the objectives of changing the appearance and gaining a better physical performance are attained quickly. The expected effects with AAS use are increase of the contractility of the muscle cell, positive nitrogenous balance, glycogen retention, amino acid capitation, and cortisol blockage (4).

Ryan (5) evaluated 25 studies investigating the increase of muscle resistance and strength under AAS use. Among these, 12 studies concluded that this medicine increased these characteristics, while 13 failed to show any increase. These results indicate the lack of consensus regarding the effects of AAS on muscle performance (6,7). The undesirable effects of AAS use are androgenic appearance in women, impotence and reduced fertility in men, prostatic

hypertrophy, increased aggressiveness, hypertension, increased blood cholesterol levels, tendon and ligament problems and hepatic toxicity, among others.

The osseous and muscle structures of the masticatory system are involved in most of the oral functions (8,9). Considering the effects of AAS such as longitudinal bone growth and the increase of muscular mass (1), frequent use of this medicine is expected to cause significant changes in the function of the masticatory system as well, mainly when associated with stress. Furthermore, we could not find any articles in dental literature dealing with the effects of AAS on the masticatory system.

The objective of this paper is to evaluate bone and dental changes in users of AAS, as well as the incidence of temporomandibular dysfunction (TMD), compared to athletes who did not use AAS.

Materials and Methods

Subjects

The study population consisted of two groups of four athletes each (all of them were unmarried, male students). The first group comprised patients who declared their use of AAS, and the second included athletes who did not use any medicine or anabolic action complement. The AAS users were 23 to 25 years old, with an average age of 24 years (SD: 1.1) and the control group subjects were 20 to 26 years old, with an average age of 22.25 years (SD: 2.6).

The subjects in the AAS users' group used two different steroids – Deca-Durabolin (decanoate of nandrolone, 50 mg/ml, Akzo Nobel Ltda., São Paulo, Brazil) and Winstrol Depot (estanozolol, 50 mg, Zambon, Barcelona, Spain) – simultaneously, to obtain a synergistic effect. The drug exposition duration is described in Table 1.

This research project had been previously approved by the ethics committee of the author's institution (Protocol number 050/2001/CEP), since all ethical aspects were taken into consideration.

Prevalence of TMD

The prevalence of TMD in both groups was determined by applying anamnetic and clinical dysfunction Helkimo indices (10,11).

Evaluation of bone and teeth alterations

The bone condition and dental positioning were evaluated by lateral cephalometric radiography superimposed over McNamara's cephalometric (12) tracing; and by cast analysis. The cephalometric tracing allowed us to determine the patients' linear measures, and diagnose vertical and/or longitudinal excess of the maxillae and/or mandible. The linear measures obtained from the patients were compared with the standard measures established by McNamara (12). A schematic presentation of the cephalogram measurement is shown in Fig. 1.

Cephalograms were traced and evaluated by a single examiner, a senior orthodontist, who was unaware of the group allocation (AAS users or non-users) (blind testing). Each cephalogram was traced three times and the average values were used. To perform cast analysis, upper and lower alginate impressions and the centric occlusion wax record of each patient were obtained. Patients were classified based on the Angle classification (13), and the arithmetic average of the perpendicular distance from the incisal edge of the upper central incisor to that of the lower central incisors represented the overjet. These measurements would help to estimate the discrepancies between maxillae and mandible in the antero-posterior dimension. Discrepancies in the transverse (lateral) dimension were observed by checking the cross-bite. A schematic presentation of the cast analysis done on a representative cast of the most common finding in the present study is shown in Fig. 2.

Results

TMD prevalence

Three of four patients in the control group presented no signs or symptoms of TMD, and they were classified as Di0 and Ai0. Only one patient showed slight symptoms and signs of TMD (AiI and DiI). However, 75% of the AAS users' group presented moderate signs and symptoms of TMD (AiII and DiII classification) and 25% were classified as AiI e DiI (Table 2). Table 3 shows the values obtained for Di mandibular mobility index, as well as total Di values in both groups, and Fig. 3 compares the averages of both groups. The Mann-Whitney test (5% confidence

Table 1 Description of the duration of drug exposure among AAS users

Volunteer	Nandrolone (mg / week)	Estonozolol (mg / 2 days)	Time of exposure (in months)
#1	75	50	3
#2	100	50	3
#3	100	50	2
#4	100	50	6

level) revealed a tendency for greater Di total values in the AAS users' group ($P = 0.096$).

Trismus and pain in the masticatory muscles were the most prevalent complaints among AAS users, and the patients reported that these complaints were more intense in pre-competition periods. The users of AAS reported chin and neck size increase, and an intense muscular rigidity, which limited, in amplitude, the head and mouth movements. In the control group, there were no physical or functional changes in the masticatory system.

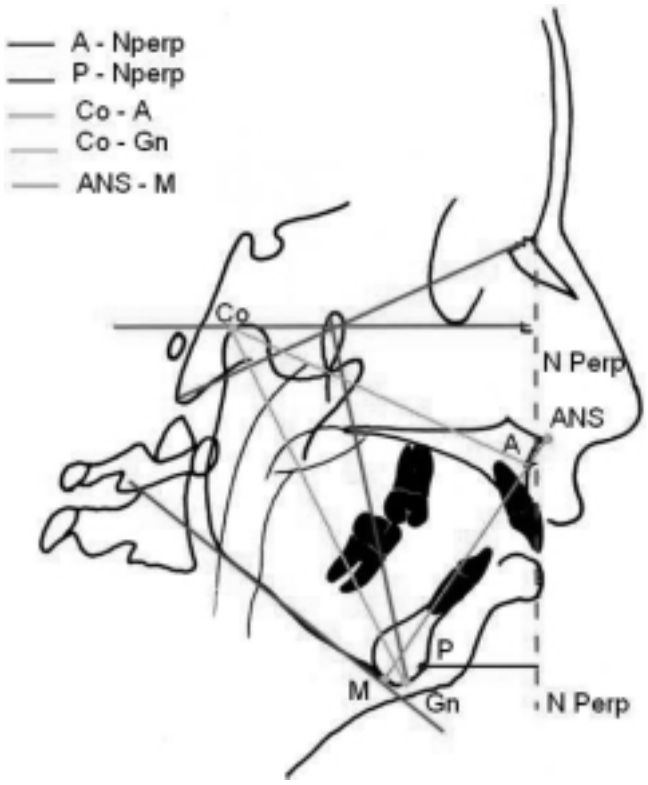

Fig. 1 Schematic presentation of the cephalogram measurements.

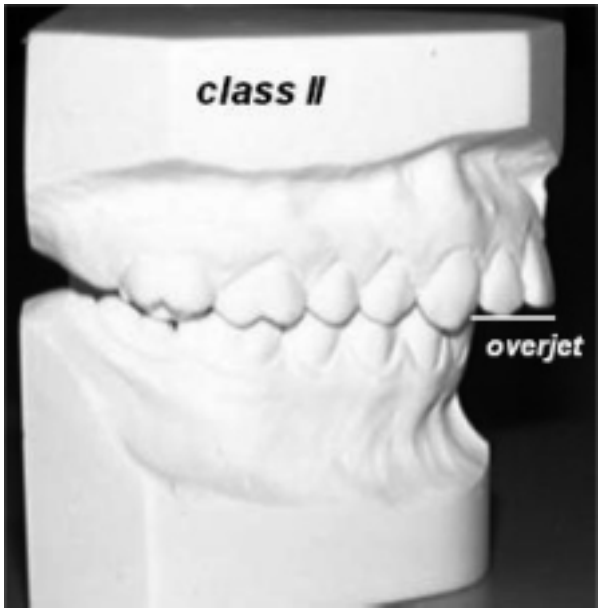

Fig. 2 Schematic presentation of the cast analysis.

Table 2 Results from Helkimo indices for both groups

	AAS users		Control group	
Volunteer	Helkimo anamnestic index	Helkimo clinical dysfunction index	Helkimo anamnestic index	Helkimo clinical dysfunction index
#1	AiII	DiII	Ai0	Di0
#2	AiII	DiI	Ai0	Di0
#3	AiII	DiII	AiI	DiI
#4	AiI	DiI	Ai0	DiI

Table 3 Di mandibular mobility index and total Di values for both groups

	AAS users		Control group	
Volunteer	Di mandibular mobility index	Di total value	Di mandibular mobility index	Di total value
#1	0	8	0	0
#2	0	1	0	0
#3	5	8	1	2
#4	1	3	1	3
Average	1.5	5	0.5	1.3
SD	2.4	3.6	0.6	1.5

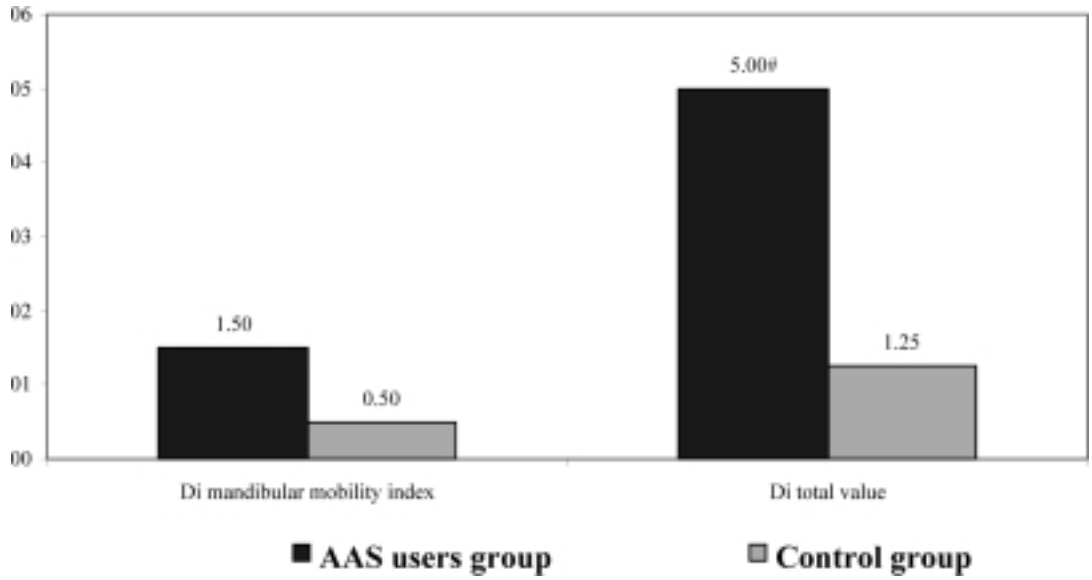

Fig. 3 Comparison of Di mandibular mobility index and Di total value averages between the groups. The # mark indicates that Di total value tended to be greater in the AAS group (Mann-Whitney test, $P = 0.096$).

Evaluation of bone and teeth alterations

A summary of the cephalometric findings is presented in Table 4 and Fig. 4. McNamara's tracing (12) revealed an increase in most of the cephalometric measures in the group of AAS users. However, a unique statistically significant difference was observed for Co-A (Mann-Whitney test, $P = 0.020$).

In the cast analysis, two of the AAS users presented a unilateral Angle class II, where the malocclusion had a functional origin and only one patient of this group presented a skeletal maxillary protrusion. The control group did not present any significant morphological alterations (Table 5).

Discussion

TMD has a multi-factorial etiology, with the main involvement of the masticatory muscles. Since AAS alters muscle physiology, we hypothesized that it would influence the incidence of TMD among AAS users.

Using the universally applied Helkimo (10,11) index to test this hypothesis, we noted that AAS users presented more intense signs and symptoms of TMD than the control group. Regarding the clinical dysfunction index, mild to moderate dysfunction was observed more in the users' group, while in the control group dysfunction was absent or mild. The Di total value tended to be greater in the AAS users' group ($P = 0.096$). This could be due to limitation of mandibular movement, trismus, pain and muscle fatigue. It may also have occurred due to an increase in the strength and muscular mass, which was not followed by structural changes in the TMJ ligament. Similar findings have already been reported by studies investigating the effects of AAS on major joints, which were subjected to intense weight and functional activities (4).

Another factor that might help to explain the increase of TMD prevalence among AAS users is the occurrence of behavioral alterations, such as aggressiveness and anxiousness, caused by these drugs (14). Since trismus and masticatory muscle pain are reported to be more intense during pre-competition periods, the above hypothesis is reinforced, since behavioral alterations are likely to be more frequent in the same periods. Furthermore, these behavioral alterations are also reported to be correlated with parafunctional habits, such as teeth grinding and clenching, which would cause TMD symptoms (8,9).

Our radiographic results suggested an increase in the cephalometric measures in the user group, probably due to AAS-induced increase in muscle mass and bone growth. There was a statistically significant difference ($P = 0.020$) between the groups in the Co-A measurement, as shown in Fig. 4. However, it is difficult to establish whether this increase was really due to AAS use, suggesting the necessity of longitudinal studies with larger samples, in order to achieve more conclusive results.

The patient position during cephalogram taking, cephalogram tracing and analysis, as well as anatomic changes causing N-Perp deviations would also influence the cephalogram results. However, all procedures were done under standard conditions in both groups with the intention of minimizing such errors. Regarding cast analysis, Angle

Class II malocclusion was more frequently observed among AAS users, with right deviation of the mandible. However, AAS use may not be the only etiological factor, and other factors like individual predisposition and bruxism should also be considered.

Sample size was a limitation of the present study. Selling AAS without medical prescription is punishable under Brazilian law, so AAS users prefer not to declare its use. That is why we could not obtain a larger sample. However, despite the small sample size, the results of this pilot study suggested that AAS would contribute to undesirable structural changes in the masticatory system and increase

Table 4 Description of cephalometric findings

	AS users					Control group				
Volunteer	A-Nperp	P-Nperp	ANS-M	Co-A	Co-Gn	A-Nperp	P-Nperp	ANS-M	Co-A	Co-Gn
#1	7.5	2.0	77.0	104.0	136.0	10.5	16.0	79.0	95.0	137.0
#2	2.0	3.0	91.0	117.0	144.0	1.0	11.5	85.0	94.0	144.5
#3	8.0	-1.5	95.0	97.0	144.0	2.5	0.0	85.0	96.0	136.0
#4	3.5	16.0	91.0	101.0	156.0	1.0	0.0	85.0	95.0	138.0
Average	5.3	4.9	88.5	104.8	145.0	3.8	6.9	83.5	95.0	138.9
SD	3.0	7.7	7.9	8.7	8.2	4.6	8.1	3.0	0.8	3.8

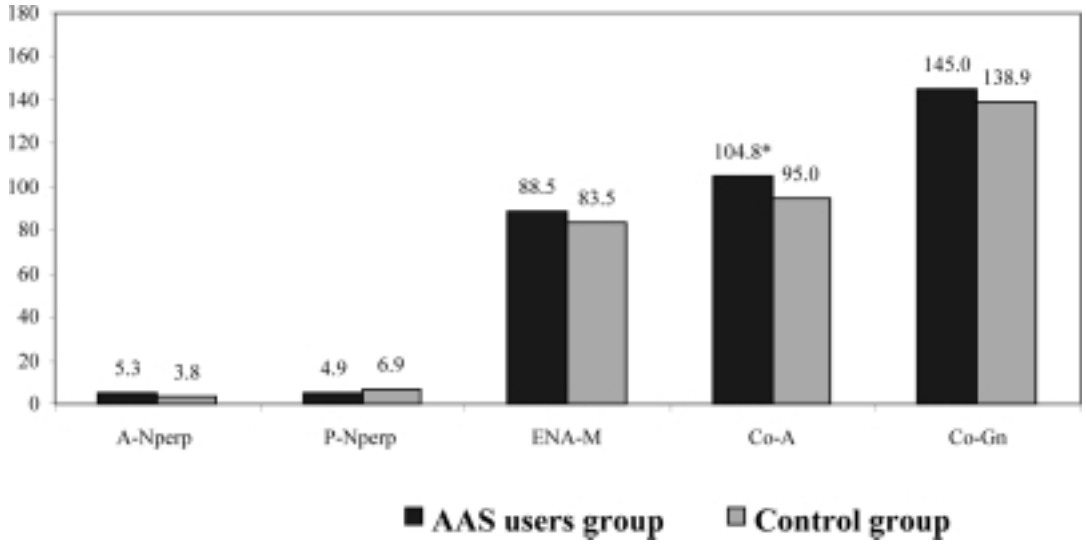

Fig. 4 Comparison of averages for cephalometric tracing between the groups. The asterisk indicates statistically significant difference between the groups (Mann-Whitney test, $P = 0.020$).

Table 5 Cast analysis results

Patient	Angle classification	Overjet > 2 mm	Cross-bite	Camber line deviation
AAS user #1	Class II - right subdivision	-	-	Right
AAS user #2	Class II - right subdivision	-	-	Right
AAS user #3	Class II division I	5 mm	Bilateral	-
AAS user #4	Class I	-	-	-
Control #1	Class I	-	-	-
Control #2	Class I	-	Unilateral right	-
Control #3	Class I	-	-	-
Control #4	Class I	-	-	-

the incidence of TMD signs and symptoms. Since the use of these drugs is increasing, more studies should be conducted in this field, in order to establish the influences of AAS on the masticatory system.

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