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Explosive Power of Legs and its Relationship to Some Mechanical Variables to Spike for the Volleyball Players

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ABSTRACT

The importance of research lies to identify the muscles power of the legs muscles for the attackers, who have to get a good jump to hit the ball, this carried out through tests to measure this character in steadiness and movement, where it is similar to the game's conditions. Also, figure out many of the mechanical values for the stages of Diagonal and Fronting spikes in volleyball, then work out to identify the values those are expected to be happened through the relationship to the explosive power of legs for volleyball players. The objectives of the research were to identify the explosive power values for the legs muscles to jump high and forward in stable for Erbil Volleyball Club, and find out the relationship of the explosive power values for the legs muscles to jump high and forward in stable with some biomechanical values of Diagonal and Fronting spikes in volleyball. The research community is consisted of Erbil club volleyball players and research sample represented of (6) players after excluding Setters and Libero. The performance of test was video recorded from two sides on the left of the performance and perpendicularly. The camera was set 3m away to the progress of the performance after that the data was entered to the laptop and analyzed by conducting two software Kinovea and Maxtraq. It has been concluded that a significant relationship between the vertical explosive power of the legs muscles with some important biomechanical variables in Fronting and Diagonal spike, for example a back chord stretches arc, hip angle from behind the best of the arc. Also there was a significant relationship between the steady explosive power of the legs muscles with some biomechanical variables in Fronting and Diagonal spike like arm angle, angular velocity for beating.

Keywords: Biomechanic, explosive, volleyball spike

INTRODUCTION

There is no doubt that many of the general and specific physical characters in volleyball especially strength, where it is an essential and important variable which contribute to increase the proficiency of the performance for volleyball skills overall and spike

particularly for both kinds Fronting and Diagonal because both of them are attacking skills and have a positive and psychological effect to increase through them the team balance points and that lead the team to win. Inasmuch there is a fundamental relationship for all kinds of strength especially explosive power which need to be improved and increase the possibility of reaching to high level of importance in performing Diagonal spike in volleyball. As well as, the optimal performance of spike needs a good and correct preparation by using many biomechanical variables which start at the beginning of the set to spike, until the completion of a strike successful and influential, in role this needs to be accurate in performing and possessing players of these variables that could be seen by eyes

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which prompting this should examine these variables using the imaging video technique then analysis the movement, which is one of the things that cannot be ignored in the scientific research, Through the above it can be seen that Biomechanical as it is science which study the technique of movement and the performance of movement visually and causally for succeeding the performance of the skill perfectly and this needs a big muscular strength from the group muscles of the lower limbs of the body to elevate the player to the level that qualifies the player to do the strike perfectly and influential. From here we can define the importance of research to identify the muscle strength of the legs muscles for the attackers who have to get a good jump to hit the ball, this carried out through tests to measure this character in steadiness and movement, where it is similar to the game's conditions. Also, figure out many of the biomechanical values for the stages of Diagonal and Fronting spikes in volleyball, then work out to identify the values those are expected to be happened through the relationship to the explosive power of legs for volleyball players to reach throughout desirable results which contribute for improving the game and set some suitable recommendations for it.

There is no disagreement of the important role of muscle strength in the process of jumping the player to the top and get the possible of bump the body to the height which can lead to perform the Fronting spike and other physical elements like speed, flexibility and agility in the performance of spike and considering this skill as an important and fundamental skill whereby the team can win. the problem of the research can be defined in studying the physical and biomechanical variables for the purpose of reaching through the search to find a role and position of strength in the performance of this offensive movement and whether this relationship between the strength of jumping high and front will reach the degree significant with the rest of biomechanical variables for the stages of Diagonal and Fronting spike for volleyball players, as well as access through this relationship to the know biomechanical values will contribute to success of this skill process. While Research object were:

1. To identify the values of explosive power for the legs muscles for steady jump to the top for volleyball players to the club Erbil.
2. To identify the values of explosive power for the legs muscles for steady jump to the front for volleyball players to the club Erbil.

3. To find the relationship between the explosive power for the legs muscles for steady jump to the top with some biomechanical variables of Diagonal and Fronting spike for volleyball players to the club Erbil.
4. To find the relationship between the explosive power for the legs muscles for steady jump to the front with some biomechanical variables of Diagonal and Fronting spike for volleyball players to the club Erbil.

MATERIALS AND METHODS

The descriptive manner survey was used to conduct this research because it is suitable for the research nature, while The research community consisted of (12) volleyball players from Erbil Volleyball Club, the research samples was included (6) players after excluding Setters and Libero, where the sample represent 50% of research community.so the Equipment and Tools used in the research:

(medicine ball 3 KG, tape measurement, 3.tape, Laptop, A camera speed 25 picture in a second, Camera stand, Volleyball court, Volleyball Balls (10), Ball Holder). Research tests were:

- The test of straight spike in Volleyball: (Mohammad, 2005)
- The test of fronting Diagonal spike in volleyball: (Ralph & Bob, 1982)
- Vertical jump test (Sargent test): (Ahmouda & Jassim, 1987)
- Standing Broad Jump test: (Albotani, 2012).

The Exploratory Experience

the purpose of exploratory experience to Identifying the work obstacles that may face the march of field experiment procedures, the researcher conducted a pilot experiment on players from Erbil Club at the same imaging day and using a video camera on Tuesday, 07/11/2014 at 4 pm and in the interior chamber of the club Erbil, The aim of the exploratory experiment is to make sure the following matters:

- (1) How efficiently to use the camera in the main experiment.
- (2) Make sure of the power of tools.
- (3) Identify the height of camera from the ground and the distance away from the performance place.
- (4) The extent to understand and respond to the sample for tests.

- (5) Guarantee rationing exercises used and the validity of the research sample.

The Main Experience

The implementation of the research experience on the same day of exploratory experiment 07.11.2014, physical tests and test the skill was conducted for the sample in indoor Erbil Club Hall, and the performance of test was video recorded from two sides on the left of the performance and perpendicularly where the height of camera was 120 cm and was set 3m away to the progress of the performance.

While the Measured Mechanical Variables were:

1. High center of gravity of the body (CGB): Is the distance measured from the center of gravity of the body to the ground.
2. Hip angle: Is the angle measured between three points and that determines the shoulder joint, hip and knee joint and is measured from the front or from behind.
3. The leg angle: Is the angle at which a leg crosses between two phases.
4. The arm angle: Is the angle at which an arm crosses between two phases.
5. Back arc depth (flight stage) is a straight line connecting the stretched bow of the back and the connecting line from the shoulder joint to the knee joint.
6. The horizontal distance of the center of gravity of the body: Is the horizontal distance crosses by the center of gravity of the body horizontally between two phases.
7. Vertical distance: It is the distance that measured vertically of the center of gravity of the body, which is calculated from the triangle that represents the horizontal distance and the outcome of the center of gravity between the two phases.
8. The horizontal distance between the take-off and landing: It is the line that linking the take-off points (the moment of leaving the ground) and a point of landing on the ground.
9. The time of the movement: The movement time was extracted by application of the following law: Total movement time = (number of aliasing images of the movement -1) × time per photo. (Abdel Wahab 1999.85).
10. Vertical Velocity: It is dividing the vertical distance by the time.
11. Horizontal velocity: It is dividing horizontal distance on time.

12. Ability: A multiplying mass to speed divided by the time.
13. Potential energy: It is multiplied the height of the center of gravity by the body weight.
14. Kinetic energy: It is multiplied the square of speed to the half of mass.
15. The work: It is dividing displacement completed by the time.
16. Angular velocity: A dividing angular distance crossed on time.
17. Pushing: It is the amount of movement which is measured through law of pushing = strength x time.

After conducting the video process, the data was entered to the laptop and was selected leg length as a measure of the drawing for each player individually and the best attempt was chosen in terms of technique and precision for the purpose of the analysis, then the following programs were used, each according to their function:(Kinovea program,Maxtraq program).

The following statistical methods were used Statistical:(Mean,The standard deviation,The coefficient of variation (r)). A computer was used for the purpose of processing the data statistically and physically using the following programs: - Microsoft Office Excel 2010 and (SPSS).

RESULTS AND DISCUSSION

This chapter show and discussion the results of relationships between spike with long jump and with high jump, the results were put in tables and discusses these results to reach the achievement of the goals of research.

From Table 1 show the values of biomechanical variables for the spike skillful test and its relationship with the vertical jump from the stability to the Straight spike in fronting area so that there was a positive relationship for the back arc variable in the flying stage with the vertical jump test, as it appeared the ratio of significant (0.05) when an error ratio is (0.05) and this attributed to the strong link of high level of explosive power for the leg muscle lead to the greater back arc distance due to the possibility of swinging arms backward in flying that will help push the trunk back more in the flying stage as swinging arms in the last touch of the land equal to the sum of swings for stages that preceded it and subsequently will increase the explosive power to push the body to the top and arch the back to back.

Table 1: Statistical descriptive of some measuring biomechanical variables for the skillful test and its relationship with the vertical jump from the stability of the sample to the straight spike skill

S. No.	Variables	Unit	Skillful test		r person		Significant
1	The horizontal distance between take-off and hitting	Centimeter	51.50	8.57	-0.41	0.43	Not significant
2	Potential energy of CGB in the last touch	Joule	9210.50	599.29	0.01	0.98	Not significant
3	Potential energy of CGB at maximum arc	Joule	13273.66	1670.13	0.15	0.78	Not significant
4	Pushing from take-off to the maximum arc	Kg. x m/sec.	186.82	41.46	-0.17	0.74	Not significant
5	Pushing from take-off to landing	Kg. x m/sec.	508.91	69.76	-0.07	0.90	Not significant
6	The angular velocity of the leg in the hitting	Degree	260.78	57.47	0.42	0.40	Not significant
7	The arc of the back in the maximum arc	Centimeter	23.83	13.56	0.81	0.05	Significant
8	Hip angle from behind the maximum arc	Degree	163.33	8.71	-0.91	0.01	Significant
9	Arm angle to hitting	Degree	53.67	7.06	0.32	0.54	Not significant
10	He angular velocity of the arm hitting	Degree/sec.	1788.88	236.33	0.32	0.54	Not significant
11	The height of the CGB in the take-off	Centimeter	112.33	3.33	-0.22	0.68	Not significant
12	The height of the CGB in the maximum arc flying	Centimeter	161.17	5.98	0.28	0.59	Not significant
13	Power	Newton	805.23	73.97	0.08	0.88	Not significant
14	Work between take-off and landing	Watt	1276.96	74.92	0.42	0.41	Not significant
15	Hip angle of the hitting in front	Degree	142.33	12.75	-0.73	0.09	Not significant

The significance level value of the error rate \leq (0.05)

Table 2: Statistical descriptive of some measuring biomechanical variables for the skillful test and its relationship with the long jump from the stability of the sample to the straight spike skill

S.No.	Variables	Unit	Skillful test		r person		Significant
1	The horizontal distance between take-off and hitting	Centimeter	51.50	8.57	-0.58	0.23	Not significant
2	Potential energy of CGB in the last touch	Joule	9210.50	599.29	0.11	0.84	Not significant
3	Potential energy of CGB at maximum arc	Joule	13273.66	1670.13	0.09	0.86	Not significant
4	Pushing from take-off to the maximum arc	Kg. x m/sec.	186.82	41.46	0.15	0.77	Not significant
5	Pushing from take-off to landing	Kg. x m/sec.	508.91	69.76	0.17	0.75	Not significant
6	The angular velocity of the leg in the hitting	Degree	260.78	57.47	-0.25	0.63	Not significant
7	The arc of the back in the maximum arc	Centimeter	23.83	13.56	-0.09	0.87	Not significant
8	Hip angle from behind the maximum arc	Degree	163.33	8.71	-0.54	0.27	Not significant
9	Arm angle to hitting	Degree	53.67	7.06	0.92	0.00	Significant
10	He angular velocity of the arm hitting	Degree/sec.	1788.88	236.33	0.92	0.00	Significant
11	The height of the CGB in the take-off	Centimeter	112.33	3.33	-0.39	0.44	Not significant
12	The height of the CGB in the maximum arc flying	Centimeter	161.17	5.98	-0.12	0.82	Not significant
13	Power	Newton	805.23	73.97	0.18	0.73	Not significant
14	Work between take-off and landing	Watt	1276.96	74.92	0.18	0.73	Not significant
15	Hip angle of the hitting in front	Degree	142.33	12.75	-0.49	0.33	Not significant

The significance level value of the error rate \leq (0.05)

A reverse significant correlation for the hip angle from behind in the flying stage with the explosive power test of the legs in standing, it was appeared that the ratio of significance is (0.01) when an error ratio (0.05) and this attributed to the strong link of high level of explosive power for the leg muscle which lead to less hip angle from the back, also affected the flexibility of the trunk, as well as help the swinging arms back in the flying stage

to push the trunk back more in the flying stage, where the swinging arms in the last touch of the land equal to the sum of swings for stages that preceded it and subsequently will increase the explosive power to push the body to the top and decrease the hip angle back.

There was any correlation appear with the rest of variables.

Table 2 show and discussion the values of biomechanical variables for the skillful test and its relationship with the long jump from the stability to the Straight spike in fronting area so that there was a positive relationship for the arm angle variable in hitting with the long jump steady test, as it appeared the ratio of significant (0.00) when an error ratio is (0.05), also there was a positive relationship for the angular velocity in hitting with the long jump steady test, as it appeared the ratio of significant (0.00) when an error ratio is (0.05) and this attributed to the strong link of high level of explosive power for the leg muscle due to the increasing of the stop time in the air and possibility of swinging arms backward in flying that will help push the trunk back more in the flying stage as swinging arms in the last touch of the land equal to the sum of swings for stages that preceded it and subsequently will increase the explosive power to push the body to the top and arch the back to back.

CONCLUSIONS

- There were significant relationships between the explosive power for the legs to vertical jump with some important biomechanical variables in the spike, a stretched chord arc back, hip angle from behind the arc.
- There were significant relationships between the explosive power of the leg in long jump with some important biomechanical variables in the spike arm angle in hitting, angular velocity in hitting.
- The explosive power of the legs, both horizontally

and vertically is necessary factor for the volleyball player in Fronting and Diagonal spike straight.

RECOMMENDATIONS

First: Interest in special physical elements of the volleyball player, including:

- Vertical explosive power of the legs.
- Horizontal explosive power of the legs.

Second: Interest in biomechanical aspects for the skill of spike because they increase the efficiency of performance, including:

- Arc stretched back in flying
- Hip angle in flying
- Angular velocity of the hitting arm
- The arm angle in hitting.

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Obstacles of the Application of Balanced Scorecard in the General Sports Federation in Syria

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ABSTRACT

This study aims to use the balanced score card as an entrance to develop management performance in the General Sports Federation in Syria. The researcher used the descriptive approach with the scanning method appropriate to the nature of the study. This study was conducted on a sample of 261 individuals from the members of the Central Council and the Executive Office and some workers in the General Sports Federation in Syria who have been selected in an intentional manner. The results of the study: There is a favorable climate of trust and ethical dealing in the General Sports Federation, the tasks that have to be done in a high level of performance to achieve the strategy of the General Sports Federation are not identified, the General Sports Federation does not work to achieve a system of feedback to raise the efficiency of its employees, the General Sports Federation does not increase his revenues by investing part of its budget, the General Sports Federation doesn't measure the job satisfaction of human resources in a continuing way, there are internal rules governing the General Sports Federation, there are no interest in developing a methodology to determine the actual training needs to be derived from the results of evaluating the performance of the employees in the General Sports Federation, The subordinates in the General Sports Federation don't participate in the decision-making process of administrative decisions.

Keyword: Obstacles, syria, balanced, sport, scorecard

INTRODUCTION

Adel mohammed zayed (2003) (82) says That the modern organizations working to keep pace with the rapid developments and successive various ways through the provision of services in the best picture to face a lot of challenges and that is the most important in the multiplicity of targets and the increasing needs of the community, diversity and the scarcity of resources and economic transformations (2:82).

Raweya mohammed hasan (2001)(215) says that management Performance is the degree of achievement and the completion of tasks, consisting of the job, which reflects how the achieve or satisfy the individual requirements, and performance can be measured on the basis of the results achieved by the individual (6: 215).

Saeed mohammed alsheemi (2000)(31) says That the development of performance management is an activity or administrative effort is intended, which aims to introduce a series of changes in the capabilities and potential of the administrative institution to play an important role in the overall development process. (8: 31) Roswitha (2000) (3) says that The Balanced Scorecard translated the message, the strategy and objectives of the organization into a indicators performance covering all the important topics of performance such as finance, personnel, internal processes and important activities and so the system

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works on the integration of financial and non-financial, input data and output, axis external (institutional funding, clients) The internal axis (operations and employees), goals and standards, causes and Consequences (7: 3).

STUDY THE PROBLEM AND THE NEED TO

The performance improvement and development became the most important challenge facing sports organizations as a necessary condition for its survival and continuity, and In order to bring about continuous improvement and development of performance, the measurement and the objective assessment of performance must be achieved. Performance measurement is a prerequisite for the success of sports organization in the application of modern approaches in the management of performance because the purpose of measuring performance is to improve the performance of the organization to determine the cases showing evidence of improvement and progress, and to document and study them. The measurement of performance is also necessary to make changes through knowing the strengths and weaknesses of the organization with development of the world of management today, emerged the theory of Balanced Scorecard that provide the theoretical framework for the measurement of performance in all the work and the procedures of the institution as it represents a model to describe the intentions of the organization and its achievements. In spite of the importance of the Balanced Scorecard as one of the concepts of modern management which was found out to be used in the field of strategic management and in measuring performance, as well it is not used in the General Sports Federation, which prompted the researcher to conduct this study to identify the Obstacles of the application of Balanced Scorecard in the General Sports Federation in Syria to applicate this balanced score card as an entrance for the development of administrative performance in the General Sports Federation in Syria as a modern approach that can address the problems of measuring performance in sports organizations.

OBJECTIVES OF THE STUDY

This study aims to use the balanced score card as an entrance to develop management performance in the General Sports Federation in Syria, through:

Identifying the obstacles that hinder the balanced score card in a General Sports Federation in Syria.

The researcher used the descriptive approach with the scanning method which is appropriate to the nature of the study, and used the questionnaire and analysis of documents as tools for data collecting.

The sample included 51 members of the Central Council out of 58 and 10 members of the Executive Office out of 13, and 200 workers in the General Sports Federation out of 332. The total sample was 261 members of the community and 64.76% of the total community of the sample and 89.69% out of the total number of the sample.

DATA COLLECTING TOOLS

The researcher constructed questionnaire depending on the scientific references and previous study, and through impervious with experts selected from field and academic professor in sport management field who have experience not less than 10 years.

DISCUSSION

From Table 2 of the frequency and percentage and connotations statistical answers phrases of the basic study sample exist statistically significant differences between the answers, that Chi-square values ranged between (19.103 – 282.851) where a phrase that refers to Goals in the General Sports Federation non-specific achieved approval rate 91.07%, then the phrase that refers to the Subordinates do not participate in the General Sports Federation in the process of decision-making and administrative decisions achieved approval rate 84%, then the phrase that refers to there is no effective communication system in the General Sports Federation achieved approval rate 82.9%, then the phrase that refers to There are conflicts and duplication of work in the General Sports Federation achieved approval rate 67.4%, then the phrase that refers to the workers Do not give the power in the General Sports Federation that needed to perform the work assigned to them achieved approval rate 64.5%, then the phrase that refers to There is a lack of collective action in the General Sports Federation achieved approval rate 63.2 %, then the phrase that refers to the services provided by the General Sports Federation Does not fit with the needs and desires of the beneficiaries achieved

Table 1: Study sample categories percentage

Group and category	Research community	Total number of sample		Basic study	
		Frequency	Percent score	Frequency	Percent score
Central management	58	58	100	51	87.93
The middle management	13	13	100	10	76.92
Executive management	332	220	66.26	200	90.9
Total	403	291	72.20	261	89.69

Table 2: Frequency and percentage and connotations statistical answers phrases of the basic study sample

Rank	Frequency (%)			Chi-square	Means	Percentage
	Agree	Rather	Disagree			
1	144 (55.2)	74 (28.4)	43 (16.5)	61.54	1.61	53.8
2	215 (7.3)	27 (10.3)	19 (82.4)	282.851	2.75	91.7
3	161 (61.7)	56 (21.5)	44 (16.9)	95.241	1.55	51.7
4	132 (50.6)	72 (27.6)	57 (21.8)	36.207	1.71	57.1
5	39 (14.9)	76 (29.1)	146 (55.9)	67.885	2.41	82.9
6	152 (58.2)	67 (25.7)	42 (16.1)	76.437	1.85	52.6
7	58 (22.2)	139 (53.3)	64 (24.5)	46.828	2.02	67.4
8	63 (24.1)	162 (62.1)	36 (13.8)	101.172	1.09	63.2
9	85 (32.6)	151 (57.9)	25 (9.6)	91.310	1.77	60.09
10	143 (54.8)	78 (29.9)	40 (15.3)	62.368	1.61	84.0
11	181 (69.3)	44 (16.9)	36 (13.8)	152.713	1.44	48.1
12	141 (54.0)	77 (29.5)	43 (16.5)	56.920	1.62	54.2
13	148 (56.7)	70 (26.8)	43 (16.5)	68.345	1.60	53.3
14	62 (23.8)	167 (64.0)	32 (12.3)	115.517	1.89	54
15	75 (28.7)	128 (49.0)	58 (22.2)	30.644	1.93	64.5
16	174 (66.7)	49 (18.8)	38 (14.6)	131.195	1.48	49.3
17	138 (52.9)	75 (28.7)	48 (18.4)	49.034	1.66	55.2

approval rate 62.8%, then the phrase that refers that administrative leaders in the General Sports Federation Does not delegate its powers to subordinates achieved approval rate 60.9 %, then the phrase that refers to The budget allocated for research and development in the General Sports Federation is insufficient achieved approval rate 57.1%, then the phrase that refers that there is no working groups in the General Sports Federation would be responsible for the development of quality performance achieved approval rate 55.2%, then the phrase that refers to There are no long-term plan to study the needs of the beneficiaries in the General Sports Federation achieved approval rate 54.2%, then the phrase that refers that No data and information are available needed for decision-making in the General Sports Federation achieved approval rate 54%, then the phrase that refers that There is no interest in improving the administrative performance in the General Sports Federation achieved approval rate 53.8%, then the

phrase that refers that There is a multiplicity of regulatory agencies in the General Sports Federation achieved approval rate 53.3 %, then the phrase that refers that There is no clarity in the relations between superiors and subordinates in the General Sports Federation achieved approval rate 52.6%, then the phrase that refers that There is no interest in research and development in the General Sports Federation achieved approval rate 51.7%, then the phrase that refers to the Lack of encouragement for workers in the General Sports Federation to contribute the maximum possible effort in developing the performance of work achieved approval rate 49.3%, then the phrase that refers to There is no relationship between rewards and performance management excellence in the Sports Federation General achieved approval rate 48.1%.

It is clear that the targets in the General Sports Federation vague and poorly defined despite the fact

that the goals represent the final outcome of the organization is trying hard to reach them.

The researcher see that the Clear objectives and specific help to optimal achievement and this is an incentive for everyone in the organization and make them feel that their goal is a goal of the organization.

Essam badawy (2001) (60) says that Goals must be clear and explicit concept to all individuals and to be linked to the personal goals of them and in order to ensure their cooperation and effort of doing their jobs (3:60).

Nazek mostafa sonbul, Maha mohammrd hasan alsagheir (2006) (67) say That the process of communication aimed at informing subordinates objectives to be achieved and policies that enhanced, programs and plans that have been developed, responsibilities and authorities which were renewed or changed in addition to informing them of the instructions regarding the implementation of actions or refrain from carrying out business in a certain way or a certain time and be notified superiors of what has been or what is being done and the problems that have emerged implementation or suggestions and problems subordinates in general (5:67).

The researcher see that participation in the decision-making make decisions more realistic and acceptable to the implementation of those who participated in the manufacture of desire and conviction that invite the employee or worker to participate in the decision-making is one of the means by which appoints administration to be sure that the psychological needs of employees and workers are growing their capabilities and expand their knowledge and bear a share of responsibility.

Abd-elaziz ben Mohammed Alhomaidee (2007) (22) says That the process of participation in decision-making is the integration of individuals mentally and emotionally in the positions of the group, which encourages them to contribute to the achievement of its objectives and carry out the responsibilities entrusted to it (1:22).

Saeid Yaseen Amer (1995) (318) says That the next stage requires a certain quality of individuals both at the management level or individuals implementing where is the human resources are the backbone to maximize the positives and minimize the negatives and must

focus on the selection of highly skilled individuals in the performance of their business and seek to attract the functional elements that have the capacity and skilled in innovation and creativity (9:318).

Farouk Ahmed Farhat (1995) (117) says that the Incentives is a system by which the administration in general and presidents in providing rewards and encouragement for employees in order to motivate them toward activating their performance and access to the maximum possible production (4: 117).

THE MOST IMPORTANT RECOMMENDATIONS

1. The General Sports Federation must work on the application of balanced scorecard as an integrated system of strategic management, and a way to rationalize the decisions of managers and guide their behavior and performance, because it's application the many benefits that contribute to strengthening the competitive position of the General Sports Federation and achieve positive results at all levels.
2. Attracting staff and technical expertise qualified who can applicate balanced scorecard efficiently and actively in the General Sports Federation.
3. Establish specialized training courses on the subject of balanced score card to train the workers in the General Sports Federation on how to apply it effectively, and the benefits achieved from it.
4. Interest in putting clear and measurable objectives, through which to give an accurate description of the work to be carried out to accomplish those goals, and thus characterization of the functional responsibilities and obligations.
5. Need to focus on instilling organizational motivating culture to measure the performance in a strong, successful and effective way. The culture of the organization in supporting the application of indicators to measure performance have credibility and acceptance from all members of the organization who are engaged in homogeneous groups of values, beliefs and traditions, standards and assumptions that govern their behavior and attitudes within the organization about continuous improvement and development of performance and the results are compatible with the objectives.
6. Focus on providing factors of enabling employees by giving them power and authority and information that improves their ability to make decisions and

solve problems. The stimulus given the importance that it deserves, with increased attention to their liking and supporting their talented achievements.

7. Work to promote a culture of quality and to encourage employees to participate in continuous improvement processes and provide opportunities for creativity and innovation.
8. The need to provide training programs that work on the rehabilitation of the leaders and presidents and workers in the field of sports, according to scientific principles and specific criteria for selecting the constant resulting from the evaluation and performance measurement.

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Orofacial Injury and Oral Hygiene in Handball Players

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ABSTRACT

The objective was to assess the oral hygiene and injury experience in handball players in relation to the gender, league level, and game position. 105 players (25 females, 80 males) were interviewed in trauma experience; additionally the oral hygiene behavior, consumption of sports drinks, and the impact of oral health on sporting performance were investigated. 52.4 % of the 105 handball players had orofacial injuries; soft tissue (mostly lip injuries) accounted for 67.6 %, nasal bone fracture for 13.5 %, dental trauma for 9.1 %, followed by jaw fracture 6 %, tongue injuries 5.3 %, chin injuries 4.5 %, and temporomandibular joint injuries 3.8 %. Main injury causes were collisions with other players (67 %), and fall (17 %). No significant gender specificity was found. The circle players had the highest prevalence of orofacial injuries (72.7 %), followed by goalkeepers (62.5 %), backcourt players (54 %), and outside position (34.6 %). Only 6 athletes used a mouthguard. Women performed a significantly better oral hygiene. More female athletes (52 %) than male (26.2%) drank weekly 4 liters sports beverages. Handball has a high prevalence of orofacial trauma, particularly lip injuries, tooth and jaw fractures, but athletes did not use mouthguards. More education, safety standards, and mouthguard use are required.

Keywords: Orofacial injuries, handball, oral hygiene, mouthguard

INTRODUCTION

In sports, the oral health can be described by three major factors: injuries, inflammation, and tooth surface integrity. All factors have local and systemic consequences.

Orofacial injuries constitute 4-18 % of all sports-related injuries (1). Reports on dental trauma due to sports showed higher percentages, between 13 % and 39 % (2-6). Results of Tuli et al. (7) indicated that sports accidents were responsible for six times as many facial injuries as work accidents and accounted

for three times more injuries than violence or traffic accidents.

Handball injuries often occur as a result of direct or indirect player-to-player contact. Due to the dynamic characteristics of the handball game there is also a high risk of head injuries.

Contact sports may cause dental trauma, and mouthguards are considered an essential equipment for athletes and an effective device to soften the impacts and to prevent injuries and their consequences (8-10). Guidelines for mouthguard use in sports have been developed by the Academy for Sports Dentistry and The American Academy of Pediatric Dentistry (11, 12). The National Collegiate Athletic Association suggests the use of mouthguards in 4 sports (football, ice hockey, field hockey and lacrosse), and the American Dental Association recommends the use of mouthguards in 29 sports/activities (13). The German Society for Oral and Maxillofacial Medicine/Dentistry identifies 15

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sports (also handball) where the mouthguard use is recommended (14). Among other reasons sport is a frequent cause for traumatic dental injuries (15). The Federation Dentaire International subdivides organized sports into two categories based on the risk of traumatic dental injuries: High-risk sports (such as American football, hockey, ice hockey, lacrosse, martial sports, rugby, inline skating, skateboarding and mountain biking) and medium-risk sports (such as basketball, soccer, team handball, diving, squash, gymnastics, parachuting and water polo) (16).

Dental trauma ranges from simple bruises or tooth fractures to complete loss of teeth and avulsion. Frequent body contact of the opponents, the high speed of arm, hand and ball are always a risk for injuries in the head and mouth area. Although orofacial injuries are common, the use of mouthguards in handball appears to be low. Many players do not use mouthguards since they expect negative effects on performance such as breathing and speaking interferences. So one purpose of this study was to evaluate the use of mouthguards by handball players and to describe their experience and causes of orofacial injuries in comparison to the league status and gender.

Oral Health and Hygiene

Inflammation of the gum depends on the interactions between bacterial plaque and personal factors, such as immune response, oral hygiene and other habits and behaviors. In sports, special exercise effects on the immune system and saliva may further impair oral health. Due to an intense, long-term training certain defense factors are reduced in the blood and saliva, which provides favorable conditions for bacteria in the oral cavity. Susceptibility to infections is therefore increased.

Another risk factor for the athletes' susceptibility for oral and throat infections is a reduction and thickening of saliva due to mouth breathing during exercise. Thereby the quality of saliva is changed, which may reduce the natural defense mechanisms. The poor level of oral health in athletes is not a new finding (17). Ashley et al. (18) showed in their study that in contrast to the common perception that athletes are healthy "all over", the oral health of sampled athletes was poor. Caries occurred in up to 75 % of athletes surveyed. The investigated athletes also experienced other oral problems such as dental erosion and dental trauma. Frese et al. (19) observed no difference with regard to

caries prevalence, but a correlation between the caries prevalence and the cumulative weekly training time.

So it was a further aspect of this study to check the oral hygiene behavior in a selected group of handball players.

METHODS

As one part of the study, a questionnaire was handed out to 105 handball players in eight teams from Saxony, Saxony-Anhalt and Brandenburg. This included 59 players from elite leagues (25 females, 17-37 years old, and 34 males, 15-19 years old), 21 male players from semi-professional leagues (17-37 years old), and 25 male recreational players (18-49 years old). The answers of all players were analyzed according to age, gender, cause and type of orofacial injuries during sport practice. The sampling frame was the incidence of trauma recorded over the entire career of an athlete (usually retrospective). Additionally the use of mouthguards was checked. Another purpose and part of the questionnaire was the assessment of the oral health and hygiene behavior. Similar questions have been used in previous studies (7, 20).

The questionnaire consisted of a short section of general information and 26 items, divided into three complexes. General data were gender, age, height, weight, together with handball specific informations, such as league membership, training volume (weekly playing time), position in the game, course content, and medical care by the association.

In the first complex the use of mouthguard was addressed. If a mouthguard was used, the type, costs and the personal reasons for the use were requested.

The second complex of questions concerned the dental hygiene behavior of the athletes as well as the frequency and the reasons for dentist visits. Further questions were related to tooth brushing frequency, the use of dental floss, the number of dental fillings as well as the consumption of tobacco and sports drinks. Furthermore, the athletes should assess their personal oral situation regarding satisfaction and limitations (in the range: not at all, a little, somewhat, a fair amount or a great deal).

The third complex addressed the injury problem in the face and mouth. The athletes were offered a choice of

orofacial injuries to answer. Also the causes of accidents were recorded.

Statistical Analysis

The statistical evaluation of the athletes was done with respect to league and gender. By means of a general linear model, ANOVA was used in order to determine the significance of differences. The level of significance was set at $p < 0.05$. For the statistical analysis a descriptive data analysis was performed to check if the incidence of injuries was associated with the following parameters: league level, age, gender and game position. The data were checked with the Shapiro Wilk-Test for normal distribution and then examined with the Spearman-Test for correlation. In the evaluation of the correlation coefficient $r < 0.4$ was set for a low correlation, $0.4 < r < 0.6$ for a medium correlation, $0.6 < r < 0.8$ for a strong correlation. All analyzes were performed using the Statistical Package of Social Science (SPSS) Version 21.0.

RESULTS

The data set of 105 subjects (25 females and 80 males) was divided into four groups according to gender and level of performance (elite to recreational). Baseline characteristics of the groups are given in Table 1. No smokers were found in the elite groups, 7 in the semi-professional, and 3 in the recreational group.

Table 2 shows the distribution of the study participants on the various playing positions. The backcourt and outside positions were most common and double filled in a team; the third most was the goalkeeper position with 15 %, followed by circle position.

Oral Hygiene Behavior and Gender Differences in the Elite Groups

Female elite players ($n = 25$) brushed their teeth significantly more frequently ($p < 0.04$) and used dental floss markedly more often than the male elite players

($n = 34$; $p < 0.005$). The importance of dental hygiene was significantly higher rated by women ($p < 0.001$). Another significant difference was the higher and more frequent consumption of sports drinks in the female elite group ($p < 0.05$), while the diet-regimen in both groups was similar (20 to 25 % (f: m)). 13 of the female players (52 %) drank an average of 4 liters sports beverages per week and the 9 male elite players an average of 5 liters. 74 % of the male elite players did not drink sports beverages. The loss of tooth substance in the front was reported by 16 % of the female and 11 % of the male elite players.

Other parameters between the elite groups showed no significant differences: Average number of dentist visits in the last 12 months: 1.6 times, and the last dentist visit before approximately 5 months. 44 % of the female players ($n = 11$) and 38 % ($n = 13$) of the male elite players had a professional tooth-cleaning. 36 % of the female and 33 % of the male players regarded their training regimen too time consuming as to access preventive dental care. Oral health-related illness was hardly a reason to miss a competition. One elite male player felt a moderate restriction in the training regimen due to dental problems.

Oral Hygiene Behavior and Gender Differences in all Groups

Female elite versus male semiprofessional group

The male semiprofessional players were significantly older (23.24 ± 5.37 years; $p < 0.02$), brushed significantly less their teeth per day ($p < 0.03$), used less frequently dental floss ($p < 0.02$), and oral hygiene was less important ($p < 0.04$). No significant differences were seen in the number of fillings, professional tooth-cleaning regimen and the restriction to assess preventive dental care due to sport. Regarding the sport drinks consumption significantly more females had an average of 4 liters per week ($p < 0.008$), whereas 3 semiprofessional males had an average of 8 liters per week. No significant differences were seen in the diet

Table 1: Baseline characteristics of the groups

Parameter	Female elite (n=25)	Male elite (n=34)	Male semi- professional (n=21)	Male recreational level (n=25)
Age	20.26±4.44	16.59±1.18	23.24±5.37	29.44±8.60
Weight	69.12±6.58	81.06±15.82	83.95±8.87	85.18±12.82
Height	1.76±7.18	1.86±8.38	1.85±6.85	1.84±8.09
Training volume	13.38±2.69	12.84±2.42	5.88±2.85	3.2±1.20

Mean values and standard deviation of age (years), weight (kg), height (m), and weekly training volume (hours) in the groups according to the level of performance

Table 2: Distribution on the various game positions

Position	n (%)		
	Male (n=80)	Female (n=25)	Total (n=105)
Goalkeeper	12 (15)	4 (16)	16 (15.2)
Outside	19 (23)	7 (28)	26 (24.8)
Backcourt (r/l)	15 (20)	7 (28)	22 (20.9)
Backcourt (c)	9 (11)	4 (16)	13 (12.4)
Circle	8 (10)	3 (12)	11 (10.5)
Not specified	17 (21)	0 (0)	17 (16.2)

Frequency (n) and percentage (%) distribution for the game positions (r=right, l=left, c=center) separated by gender

regimen or the awareness of dental erosions at the anterior teeth.

Female elite versus male recreational players

The male recreational handball players were significantly older (29.44 ± 8.60 years; $p < 0.0001$), brushed significantly less their teeth per day ($p < 0.01$), oral hygiene was significantly less important ($p < 0.008$), and the number of fillings was markedly higher ($p < 0.001$). The demanding training regimen of the female athletes made it significantly more difficult to have preventive dental care ($p < 0.005$). No significant differences were seen in the use of dental floss, professional tooth-cleaning regimen, diet regimen, notice of dental erosions, and in the sport drinks consumption. The female elite and all male players who consumed regularly sports beverages ($n = 34$) had the same weekly consumption of 4 liters, and 5 from these (3 females and 2 males) noticed tooth substance loss in the anterior teeth.

An average of one third of all elite players felt limited in time due to the handball sport. This was in contrast to 19 % of the semiprofessional and 4 % of the recreational group. The difference between the elite and recreational group was very significant.

No differences between the groups regarding the satisfaction with their oral situation were seen. From all elite and semiprofessional players ($n = 80$), 5 athletes (6 %) could not attend the training due to tooth or oral problems, and 2 athletes (2.5 %) could not participate in a competition for this reason.

Oral Hygiene Behavior and Differences in the Male Groups

The participants from the elite male handball group had significantly less fillings than the males from the semiprofessional ($p < 0.05$) and recreational

group (0.0001). So the recreational players had the most fillings, also significantly more than the semi-professional players ($p < 0.04$). On the other hand more than 50 % of the recreational players had a professional tooth-cleaning in the last 12 month, which was significant when compared to the semi-professional group ($p < 0.01$). A comparison of the time limitation for dentist visits showed a significant limitation of the elite versus the recreational group ($p < 0.007$).

92.5 % of the 80 male players reported to brush their teeth twice per day, one brushed his teeth 3 times and the remaining 6 % cleaned their teeth 1 time per day. Dentist visits in the last 12 months were: 2 visits in 41.2 %, one visit in 37.5 %, none in 5 %. 10 % of the male players reported 3 to 5 visits. A small portion of 3.7 % had 8 to 12 dentist visits. The most common reasons were the biannual control ($n = 34$) und annual control ($n = 27$), followed by tooth pain ($n = 9$), professional tooth-cleaning ($n = 7$), problems with the wisdom teeth ($n = 4$), and the loss of a filling ($n = 2$). Multiple nominations were possible.

Orofacial Trauma

Since there were very young players with high training volumes but with a short sporting career, and also older athletes with a low training volume but a long sporting career, age groups were configured.

The age groups were: 10–19 years ($n = 57$), 20–29 years ($n = 35$), and 30–49 years ($n = 13$). The distribution of orofacial injuries according to the age and gender is shown in Table 3. From the 105 participants were 16 goalkeepers (4 females and 12 males). About 50 % of the participants reported orofacial injuries.

133 orofacial injuries were documented, and multiple answers were possible (Table 4). Most frequent lesions were lip injuries, facial lacerations, bruises, and nasal bone fractures. Tooth loss occurred once. No one had a fracture of the cheek bone. Nasal bone fractures occurred in 13.5 %, tooth fracture in 8.3 % and jaw fracture in 6 %. Temporomandible joint (TMJ) injuries occurred in 3.8 %. Collisions with other players were accounted for the majority of the injuries (67 %), followed by fall (17 %), ball contact (11 %), and collisions with obstacles (5 %).

In the following the orofacial injuries frequencies are considered in relation to gender, league level,

Table 3: Handball related orofacial injuries - distribution by age and gender

Age	Female players		Percentage of injured female players	Male players		Percentage of injured male players
	Injured (n)	Total (n)		Injured (n)	Total (n)	
10–19	6 (incl. 1 GK)	14	42.8	19 (incl. 4 GK)	43	48.7
20–29	6 (incl. 1 GK)	9	42.8	13 (incl. 2 GK)	26	33.3
30–49	2 (incl. 1 GK)	2	14.4	7 (incl. 1 GK)	11	18
Total	14	25	100	39	80	100

Gender and age (years) related orofacial injuries in handball. Abbreviations: incl.= inclusive, GK=goalkeeper

Table 4: Category of injuries in the groups

	Female elite (n)	Male elite (n)	Male semi-professional (n)	Male recreational level (n)	Number	Percentage
Orofacial trauma in the career	14 (56%)	17 (50%)	13 (62%)	11 (44%)	55 (52.4%)	
Lips injuries	5	8	5	4	22	16.5
Oral laceration	2	8	5	4	19	14.3
Nasal bone fractures	8	2	4	4	18	13.5
Facial laceration	6	4	4	4	18	13.5
Facial bruise	5	5	3	5	18	13.5
Tooth fracture	3	1	3	4	11	8.3
Tongue injuries	4	1	2	0	7	5.3
Chin injuries	2	1	2	1	6	4.5
Mandible fracture	2	3	1	0	6	4.5
TMJ injuries	2	2	1	0	5	3.8
Maxillary fracture	0	2	0	0	2	1.5
Tooth loss	0	0	0	1	1	0.8
Cheek bone fracture	0	0	0	0	0	0
Total	39	37	30	27	133	100

Number (n) and percentage (%) of orofacial injuries in all groups. Abbreviation: TMJ=temporomandibular joint

player`s position in the game, age, and amount of sports activities. The male players had an average of 1.18 orofacial injuries per subject and the female players an average of 1.56. No gender specificity could be established. According to the league level of male players we found an incidence of 1.09 orofacial injuries in the elite, 1.43 in the semiprofessional, and 1.08 in the recreational group. Correlation analysis showed no significance between the amount of sports activities and the incidence of injuries, and also between the age and incidence of orofacial injuries.

We also looked at the player`s position and relation to the average rate of orofacial injuries. 17 from 105 handball players reported no specific game position. With the game positions (n= 88), the following differences in the incidence and distribution of 99 injuries was seen:

- **Circle position:** 8 (72.7 %) of 11 circle players had a sum of 17 orofacial injuries, i.e. 1.5 injuries

per subject: Soft tissue injuries (n= 13): Facial laceration: 3, lip injuries: 2, oral laceration: 3, tongue injuries: 1, chin injuries: 0, bruise: 4. Bone, tooth, joint injuries (n= 4): Nasal bone fracture: 3, maxillary fracture: 0, mandible fracture: 0, tooth fracture: 1, TMJ: 0.

- **Goalkeeper position:** 10 (62.5 %) of 16 goalkeepers had a sum of 24 orofacial injuries, i.e. 1.5 injuries per subject: Soft tissue injuries (n= 15): Facial laceration: 5, lip injuries: 5, oral laceration: 3, tongue injuries: 1, chin injuries: 1, bruise: 0. Bone, tooth, joint injuries (n= 9): Nasal bone fracture: 3, maxillary fracture: 1, mandible fracture: 0, tooth fracture: 1, TMJ: 4.
- **Backcourt side position:** 12 (54.5 %) of 22 backcourt side players had a sum of 37 orofacial injuries, i.e. 1.7 injuries per subject: Soft tissue injuries (n= 29): Facial laceration: 3, lip injuries: 9, oral laceration: 7, tongue injuries: 4, chin injuries: 2,

bruise: 4. Bone, tooth, joint injuries (n= 8): Nasal bone fracture: 3, maxillary fracture: 0, mandible fracture: 1, tooth fracture: 4, TMJ: 0.

- **Backcourt center position:** 7 (53.8 %) of 13 backcourt center players had a sum of 12 orofacial injuries, i.e. 0.9 injuries per subject: Soft tissue injuries (n= 3): Facial laceration: 1, lip injuries: 1, oral laceration: 0, tongue injuries: 0, chin injuries: 1, bruise: 0. Bone, tooth, joint injuries (n= 9): Nasal bone fracture: 2, maxillary fracture: 1, mandible fracture: 4, tooth fracture: 1, TMJ: 1.
- **Outside position:** 9 (34.6 %) of 26 outside players had a sum of 9 orofacial injuries, i.e. 0.3 injuries per subject: Soft tissue injuries (n= 5): Facial laceration: 2, lip injuries: 1, oral laceration: 1, tongue injuries: 0, chin injuries: 1, bruise: 0. Bone, tooth, joint injuries (n= 4): Nasal bone fracture: 2, maxillary fracture: 0, mandible fracture: 1, tooth fracture: 1, TMJ: 0.

So from the incidence of injuries a game position specificity was revealed: players at the backcourt side, goal and circle position are particularly susceptible to injuries. Players at the backcourt side position had the highest average rate of 1.7 orofacial injuries, players at the goal and circle position had an average rate of 1.5, followed by the backcourt center position with an average rate of 0.9, and outside position with an average rate of 0.3.

Mouthguard

5 (5.7 %) from 89 handball players and 1 (6 %) from 16 goalkeepers used an individual mouthguard in handball games with an average cost of 140 € (100 – 200 €). 2 female players of the elite and 1 goalkeeper of the recreational group had a tooth fracture and decided therefore to wear a mouthguard, and 3 male players of the semi-professional group wore an individual mouthguard for prophylactic reasons.

DISCUSSION

The overall objective of the present investigation was to study the differences in oral health behavior and frequency of orofacial injuries in handball players of different league level, training volume, and gender.

Oral Health Behavior

Appearance and determinants of social life such as self-confidence, attractiveness and life quality are markedly

influenced by the oral health. Furthermore, oral health may impair general health significantly. For example, rheumatic or acute inflammatory heart valve diseases and coronary artery disease may arise from bacteria in the oral cavity (21, 22).

Out of 105 surveyed athletes 46 (43.8 %) reported that oral hygiene is “very important “ and 53 athletes (50.5 %) described the oral hygiene as “important. Proper dental care can be assessed by specific parameters. Important for an optimal oral hygiene is at least a daily twice tooth cleaning and the use of dental floss or interdental brushes. According to the Market Research Institute Novia Data 81 % of German people brushed their teeth daily, 39 % use dental floss and 46 % use mouthwash. Only 4 out of 5 men brushed their teeth regularly.

The statement that men care less to oral hygiene was to be checked. Female elite players brushed their teeth significantly more frequent and used dental floss significantly more often than the male elite players. All men groups brushed significantly less frequent, oral hygiene was less important for them, and the semiprofessional players used dental floss significantly less frequent than the females.

The oral hygiene habits for the primary prevention of tooth caries and periodontal diseases in regard to infectious plaque control have a prominent position. Out of the 80 examined male handball players 93.5 % brushed their teeth twice a day or more often, and 6 % only one time every day; considering the females alone, all brushed their teeth twice or more every day.

According to DMS IV (23) 84 % of the 15 year old and 35 to 44 year old subjects brushed their teeth twice a day. The present study showed an even more positive image of 100 % in females and 93.5 % in males who brushed teeth daily twice or more in a range of 3 minutes.

In this present study the women performed significantly better in comparison to the male groups with respect to oral hygiene and its importance, regardless of the age. This is in line with other reports about apparent gender effects on oral hygiene behavior. Data concerning worse oral hygiene behavior in males were also found in the following studies: Alcouffe (24) reported in a very small group (26 women, 28 men) a better oral hygiene in women. Karikoski et al. (25) assessed the effects of oral self-care on periodontal health indicators among adults.

Women reported brushing their teeth more frequently, and had significantly less plaque than men. Strauss and Stefanou (26) reported in 573 adults that females practise more often daily interproximal cleaning. Schulze and Busse (27) reported in 517 adults (obese, diabetic and non-diabetic) that females performed a better oral hygiene.

In the present study only 26 participants (24.8 %), 13 females (40 %) and 13 males, used floss at least twice a week. Though tooth-cleaning twice a day is performed by the majority of the participants, the fewer use of dental floss may increase the probability for approximal or interdental caries or gingivitis. The responses of DMS IV (23) in the adult cohort showed a use of dental floss in 40 %, so in the present study were only the women in line with this study and men performed significantly worse. Tooth brushing may be effective in removing plaque on buccal and lingual surfaces, but it will not reach the interdental plaque. A number of other hygiene devices are available to accomplish this: dental floss, interdental brushes, and toothpicks. Periodontal and gingival lesions are predominantly observed in the interproximal or interdental sites; these sites are most frequently coated with plaque. A toothbrush cannot completely clean the interdental surfaces, so interproximal cleaning represents an important aspect of oral self-care and has beneficial effects on plaque and gingival health (28, 29). Due to the importance of interproximal cleaning, it is surprising that only few studies exist on this topic. Anyway, the present study shows very plainly that the frequency of interproximal cleaning in all groups was far below the recommendations of daily practice, and the men were worse than in the results in DMS IV (23).

Sports can also have negative consequences on the oral situation. Particularly competitive sports athletes spend a lot of time in training and competitions, which may have the consequence that they have less time for other activities or health care. The majority of subjects in this study felt not restricted in oral health care by the sport, probably as an effect of the predominantly good dental hygiene behavior. The athletes had only few acute dental problems, and the majority was not limited in the performance and training ability by their teeth and mouth situation in the last 12 months.

Consumption of Acidic Sports Drinks

The consumption of isotonic drinks was also reported in this study. More female athletes (52 %) than male (26.2

%) drank 4 liters acidic sports beverages per week. All together (n=105) drank an average of 1 liter per week. However, the use of these beverages may cause dental erosion. Rees et al. (31) reported that sports drinks based on acidic fruits popular in the United Kingdom have low pHs, and are erosive when enamel is immersed in the sports drink. So sports beverages can produce substantial surface loss and surface softening (32).

In the present study, 14 athletes (13.3 %; 10 males and 4 females) claimed to notice a substance loss at the anterior teeth, but only 3 women and 2 men of these consumed regularly acidic sports beverages. So also other reasons for tooth substance loss, e.g. such as eating disorders, can be considered. Prolonged beverage holding habits, or mouth breathing may also increase the risk for dental erosion (33). Further causes include the diet (34), decreased salivary flow during exercise (35), and exercise-induced immune suppression (36). Substance loss of the anterior teeth can also be seen in traumatic injuries, which also were investigated.

Orofacial Injuries

Accidents cannot be avoided in handball. The head in particular is an extremely sensitive part of the body, and serious injuries can occur. A strategy of prevention, however, is unlikely to realize its full potential unless there are reliable data about the incidence, and localization of injuries.

To obtain an overview of orofacial injuries, 105 handball players were investigated. 52.4 % (n= 55) had suffered from orofacial injuries. Soft tissue injuries occurred in 68 %; lip injuries were most prevalent (16.5 %), followed by oral lacerations (14.3 %), contusions, facial lacerations (each 13.5 %), and chin injuries (4.5 %). Hard tissue, bone and joint injuries accounted for nearly one third (32.4 %), in which nasal bone fracture was most prevalent (13.5 %), followed by dental trauma (9.3 %), with emphasis on maxillary central incisors, followed by jaw fracture (6 %) and temporomandibular joint (TMJ) injuries (3.8 %). This means that the orofacial region is extremely vulnerable. Two-thirds of the orofacial injuries were soft tissue injuries. The tissue absorbs the forces, and thus acts as a buffer for the teeth and jaws. 11 from 105 handball players have experienced dental injuries. This is in line with Lang et al. (37), who found 12 from 112 handball players with dental injuries (10.7 %). The use of a mouthguard may prevent or attenuate dental and oral injuries. Despite

its positive effects, mouthguards are rarely used. Only a very small percentage (5.7 %, n= 6) of the surveyed subjects actually used a mouthguard in the handball games, 3 of them after tooth fracture, and the other 3 just as a preventive tool. Obviously former accidents resulted in the willingness to use mouthguards in 50 % of the handball players with dental injuries. This shows that new motivating tools must be developed to improve the acceptance for mouthguards in the future.

The differentiation between the league levels showed the highest prevalence of orofacial trauma in the semiprofessional group (62 %), followed by the elite groups (53 %), when compared with the control recreational group (44 %). This resulted in an average of 1.09 orofacial injuries in the elite, 1.43 in the semiprofessional, and 1.08 in the recreational group. A gender-specificity was not seen in the present investigation. The male players had an average of 1.18 orofacial injuries and the female players an average of 1.56. No specificity was also reported by Wedderkopp et al. (38) and Olsen et al. (39).

The athletes gave retrospective information about the sum of injuries in their sporting career. For this reason, no comparison of the incidence of injuries in a given period was possible. Furthermore, only a minimum number of injuries in the orofacial complex could be seen from the responded data. Multiple nominations were not provided in the questionnaire.

In the present study, no correlation was seen between the frequency of orofacial injuries and the age. Also, the training volume was not decisive for the athletes' frequency of orofacial injuries based on this investigation. It is recommended to train several times in the week, so the body can adapt to the workloads and is prepared in the game for various situations. Nevertheless unpredictable situations often occur, such as the action of the opponent player in the jump or personal deficient reflexes. The most frequent cause of injury was a blow from another player and fall (84 %).

We also looked at the players' position and relation to the average rate of previous orofacial injuries. The circle players had the highest prevalence of orofacial injuries with an average of 72.7 %. The circle player is in constant contact with the defenders. Holding, pulling and pushing are the normal movements in the defense. The permanent contact between aggressive opponents and circle players increases the injury risk.

Circle players must block the attacks in a variety of conditions, catch passes and throw at the goal. Many times the circle players jump into the circle respectively perform a drop throw at the goal. If the player loses the balance and his body is out of control, he is no longer able to intercept the fall optimally. In the present study the orofacial injuries in this position were mainly bruises, lacerations and nasal bone fractures. In most cases these accidents happened due to a collision with the opponent's defenders.

Goalkeepers had also a high incidence of orofacial injuries (62.5 %). Specific injuries were facial lacerations, lip injuries, and oral lacerations. Nasal bone fractures and furthermore the most TMJ injuries occurred in this position (n= 4). Associated with this position is a high risk of a collision with the ball or with the goal post.

The backcourt players on the half positions had an injury incidence of 54.5 %. Forced jumps with fast vigorous throws are typical for this position. This investigation revealed lip and tongue injuries, lacerations to the mouth and the face. Nasal bone and the most tooth fractures (n= 4) were reported, and also bruises and chin injuries. In all other positions we found only one tooth fracture.

53.8 % of the backcourt center players had orofacial injuries. In this position nasal bone fractures and a relatively high number of jaw fractures (n= 5) were reported, also one tooth fracture, tooth loss, and one TMJ injury. Significantly fewer orofacial injuries were observed in the outside positions.

The risk of injuries in handball is extremely high due to the dynamic and powerful game character. Fast movements with many changes of the direction and frequent opponent contacts make the game attractive and exciting for the spectators. Due to direct and partly hard contacts with the opponents a relevant risk of traumatic injuries is always present. In particular aggressive defensive behavior with pushing and pulling of the opponents is a trigger for injuries. Throws at the goal can miss their target and cause serious injuries.

A dental crown fracture is irreversible. Tooth dislocation or avulsion may result in a tooth loss due to ankylosis or infection-related root-resorption (40). Even a minor tooth injury like a concussion can potentially cause pulp necrosis.

An injured tooth often requires extensive treatment just to become functional again and can create a lifetime of expensive, long-term problems for the affected athlete (41-43). In terms of the high rate of orofacial injuries, shown in this study, the use of a mouthguard is recommended.

CONCLUSION

In handball more information and education of the coaches, clubs and players about the high risks of orofacial injuries and their prevention is necessary. Circle players had the highest prevalence of orofacial injuries (72.7 %), followed by goalkeepers (62.5 %) and backcourt players (54.5 %). Only 6 of 105 investigated players used a mouthguard, 3 of them after dental trauma. New motivating tools have to be developed to improve the acceptance for mouthguards in handball, where the most frequent cause of orofacial injury was a blow from another player or fall. Females performed a better oral hygiene than the male players.

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