INTRODUCTION

Success of shots (expressed in percentage of goals from the entire number of shots) generally belongs to the principal factors influencing the results of a match in handball (Taborsky 1989). Approximately one half of shots which are aimed at the goal during the match are the shots from the space of backs. From this space it is possible to shoot at the goal in several ways. We consider the technique is as one of the most important factors for the success of shot from the space of backs. Analysis of technique performed by top level players enable a possible to set critical points in the performance of single kinds of the shots. In the year 1996 there was published an analysis of technique of the jump shot in the official magazine of the EHF (HANDBALL). This analysis was performed on a national Croatian men's team, who won the handball tournament at the Olympic Games in 1996 (Zvonarek-Hraski 1996). Using comparable equipment (APAS - CMAS) we performed a similar analysis on women's handball teams on the same representative level. (National team of Norway [NOR], Germany [GER], Czech Republic [CZ] and Austria [AUST]).

METHODS

We have used a method of three dimensional analysis of movement with the help of the kinematic analyser CMAS, which is constructed on the same principle as the analyser APAS. With the two cameras in static positions we recorded movement in a calibrated area (100 x 200 x 700 cm) in the frequency of 25 frames per second. The data were digitalised at 17 segment models of a human body (19 reference points with one additional point for the ball).

Video material was produced during the trainings of the national women's teams tournament in the Czech Republic in January 1995. Together there are 20 players who participated in the presented results (CZ.6, NOR 6, GER 4, AUST 4). During the tournament these athletes played the matches practically only as backs. We filmed during the morning trainings the situations when the players had a single task - shoot at the goal from the area of backs with the strongest effort. That means that we avoided an influence of game situations including some of psychological factors (e.g. development of goal score, presence of the audience, etc.). Every player had two attempts so together we could use 40 examples of the jump shot. Like the authors of the Croatia study [CRO] we have also chosen one jumpshot which can be considered as a typical model.

RESULTS:

For analysis we devised a model performance of the jump shot to the five phases: Approach, take off, flight, throw and landing. Our analysis is concerned only with the first four phases because the landing according to us doesn't influence either the provision of the first four phases or the result of the shot, (in the moment of landing the body of the player is not in contact with the ball anymore and can't influence the characteristics the ball's flight).

APPROACH - With the approach we understand two or three steps which precede the take-off. The approach brings the optimal horizontal velocity. In our case the horizontal velocity increased for 0.73 ms⁻¹ [CRO = 1.4 ms⁻¹]. The last step is also used
for the preparation of transferring the horizontal impulse into the vertical. We can observe that CG decreases. The analyzed player decreased CG in last step for 5 cm [CRO= 11.3 cm].

TAKE OFF - The take-off we consider the interval lasting from the first to the last contact of the taking-off of the leg from the ground during the last step. It is possible to characterize it with decreasing of horizontal and growing of vertical CG velocity at the same time. With that it achieves higher position in axis Y. Horizontal velocity of the analyzed player decreased for 1.41 ms\(^{-1}\) [CRO 1.63 ms\(^{-1}\)] and her vertical velocity rose for 4.29 ms\(^{-1}\) [CRO 1.68 ms\(^{-1}\)]. The CG position in axis Y rose to 121 cm [CRO 143.5 cm] during this interval.

FLIGHT - It is possible to consider the CG trajectory during the flight of the body from the moment of take-off as a parabola. For us the top of the CG trajectory is the most important because the height of the jump can be very important in determining whether the jump shot is successful. In our case the height of CG at the top of flight was 165 cm, that means that from the moment of take-off the CG increased for 44 cm [CRO 27 cm]. Also information about CG movement in axis X (forward movement) are very interesting. CG was moved at the top of flight for 77 cm to the front in the moment of the throw for 144 cm to the front [CRO 71.5 cm]. In summation that means that the analyzed player doesn't throw the ball before the decreasing phase of the flight starts.

THROW - The most interesting throwing characteristics are those which describe the function of the kinematic chain, that means the maximum velocity of the centers of the points (joints) at every segment of the body. The function of the kinematic chain is based on energy transfer from the main segments of the body to the ball. Like the Creation study our analysis confirmed the theoretical assumption that the closer the point is to the ball the higher will be the maximum velocity. The velocity was increasing in the following order: hip 3.82 ms\(^{-1}\) [CRO 4.13 ms\(^{-1}\)], shoulder 6.10 ms\(^{-1}\) [CRO 6.93 ms\(^{-1}\)], elbow 9.18 ms\(^{-1}\) [CRO 16.83 ms\(^{-1}\)], hand 15.2 ms\(^{-1}\) [CRO 20.41 ms\(^{-1}\)]. The ball left the hand with velocity 20.88 ms\(^{-1}\) [CRO 25 ms\(^{-1}\)] and the hand was at the height of 2.55 m above the ground [CRO 2.71 m] at this moment.

CONCLUSION

Comparing two model performances of the jump shot we ascertained that there is almost no difference in technique between men and women - it is based on the same principle. As we expected we found only differences in the absolute values of kinematic characteristic caused by men's somatic advantages. The only difference can be the moment when the ball is leaving the hand because while men provide this action at the moment when the CG of the body is in the highest point of flight, women don't start to throw until the decreasing phase of flight. The number of analyzed attempts was not very high (12 attempts for men and 40 attempts for women) it is not possible to generalize the difference. It is also necessary to note that during a match the players change the moment when the ball leaves the hand according to the unique game situation.

REFERENCES:
For this reason, the jump shot is considered to be the most important element of technique in basketball and requires a high level of performance. The aim of this study was to compare the biomechanical characteristics of the lower limbs during a jump shot without the ball and a countermovement jump without an arm swing. The differences between variables provide information about the potential that an athlete can utilise during a game when performing a jump shot. The study was conducted among 20 second-league basketball players by means of a Kistler force plate and the BTS SMART system for moti KEY WORDS: team-handball, jump throw, 3D-analysis.

INTRODUCTION: The purposes of our study were to determine the proximal-to-distal. sequence of the linear joint and angular velocities and to measure the influence of maximal. angular velocities and performance level to ball release speed of the jump throw, which is the. The aim of this study was to compare the kinematics of the overarm throw for different sports. Eleven elite female handball players and nine elite female volleyball players were selected as subjects for the study. Arm and forearm segment movement in the backswing and acceleration phases of players performing the volleyball spike and the handball jump shot were evaluated. Video data were captured