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KINEMATICAL VARIABLES ANALYSIS OF DISCUS THROW ACTIVITY IN PARA-ATHLETICS (CLASS F57) AND THEIR RELATIONSHIPS WITH DIGITAL LEVEL ACHIEVEMENT. PART I.

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Abstract: The aim of this study is to analyze kinematical variables of discus throw activity in Para-Athletics F57 and to investigate their relationships with digital level achievement. International Para-athlete "Saifi Nassima" participated voluntarily in this study. The athlete throwed the discus with her right arm. Recordings were made by synching cameras (*AEE MagicCam, 170° view, MOV Format Video, 720p Video Resolution, 120 ips NTFS*, *Screen Resolution 1280*720 16:9*) for side and rear views by a LANC (*CONTROL-L*) device. The athlete wore reflective markers to track their motions on joints of the wrists, the elbows, the shoulders, the hip center, and down the neck with the least possible number of occlusions, to analyze the length and angle of movement by the x and y axis. The best six throws during the first and second phases (*start and finish throwing*) of the discus throw were included for analysis in two-dimensional by Dartfish.9 software. Means, standard deviations, minimum and maximum values were applied as descriptive statistics, and Pearson test for the correlations between all variables. As a result, there was a positive significant correlation of digital level with cubitus angle of the throwing hand ($p< .001$), trunk angle ($p< .005$) in the first phase, and with disk flight time ($p< .005$), throwing angle ($p< .001$) in the second phase. In conclusion, we confirm that the increase in the values of the variables of distance shot from the armrest, and the wrist angle of the shooting hand in the first phase of throwing, affects the digital level achievement. The decrease in the value of the throwing angle variable in the second phase of throwing affects the digital level achievement.

Keywords: Kinematical variables, para-athletics, discus throw, digital level.

PARA-ATHLETİCS (SINIF F57) DİSK ATMA AKTİVİTESİNİN KİNEMATİK DEĞİŞKENLERİN ANALİZİ VE DİJİTAL SEVİYE BAŞARISI İLE İLİŞKİLERİ. BÖLÜM I.

Öz: Bu çalışmanın amacı, Para-Athletics F57'de disk atma etkinliğinin kinematik değişkenlerini analiz etmek ve bunların dijital seviye başarısı ile ilişkilerini araştırmaktır. Uluslararası Para-atlet "Saifi Nassima" bu çalışmaya gönüllü olarak katıldı. Sporcu diski sağ koluyla fırlattı. Kayıtlar, bir LANC (CONTROL-L) cihazı ile yan ve arka görünümler için kameralar (AEE MagicCam, 170° görünüm, MOV Format Video, 720p Video Çözünürlüğü, 120 ips NTFS, Ekran Çözünürlüğü 1280*720 16:9) senkronize edilerek yapılmıştır. Sporcu, x ve y ile hareketin uzunluğunu ve açısını analiz etmek için mümkün olan en az sayıda oklüzyonla bilekler, dirsekler, omuzlar, kalça merkezi ve boyundaki eklemlerdeki hareketlerini izlemek için yansıtıcı işaretleyiciler taktı. eksen. Disk atışının birinci ve ikinci aşamalarındaki (başlangıç ve bitiş atışları) en iyi altı atış Dartfish.9 yazılımı ile iki boyutlu olarak analize dahil edilmiştir. Tanımlayıcı istatistik olarak ortalamalar, standart sapmalar, minimum ve maksimum değerler, tüm değişkenler arasındaki korelasyonlar için Pearson testi uygulandı. Sonuç olarak, dijital seviye ile fırlatan elin kubitus açısı ($p< .001$), birinci aşamada gövde açısı ($p< .005$) ve disk uçuş süresi ($p< .005$) ile pozitif ve anlamlı bir korelasyon vardı.), ikinci aşamadaki atış açısı ($p< .001$). Sonuç olarak, atışın ilk aşamasında kolçaktan atış mesafesi ve atış yapan elin bilek açısı değişkenlerinin değerlerindeki artışın dijital seviye başarısını etkilediğini doğruladık. Fırlatmanın ikinci aşamasında fırlatma açısı değişkeninin değerindeki azalma, dijital düzeydeki başarıyı etkiler.

Anahtar Kelimeler: Kinematik değişkenler, para-atletizm, disk atma, dijital seviye

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INTRODUCTION

Paralympic games are a multi-sport event for athletes with physical, mental, and sensorial disabilities. This includes mobility disabilities, amputees, visual disabilities and those with cerebral palsy (Brittain, 2016). Discus throw is one of the oldest sports in athletics. It is one of the four throwing events in track and field (Hay and Yu, 1995). Complicated movements performed at high speed in a limited space make the discus throw technically and physically very demanding (R. M. Bartlett, 1992). The technically and physically demanding nature of the discus throw requires thorough biomechanical studies to have a good understanding of the techniques and training of elite discus throwers (Dapena, 1994). It has been studied for a long time by coaches, scientists and biomechanics experts. Biomechanics is the main field of objective research into the technical rules and methods of various kinetic skills (Guebli, Regiueg, et al., 2018). Kinematic analyses of the throwing techniques of elite stationary discus throwers are commonly conducted in routine observations and sport research (Guebli Abdelkader et al., 2018). Therefore, biomechanical knowledge is a “must” for coaching(Abdelkader et al., 2021; Arguz et al., 2021). All movements of athletes are determined by the laws of mechanics. Few studies involving discus throw (especially in disabled athletes) describe the forces which act on discus flight phase. It may be caused by minor release velocity and flight time, short trajectory so that it decreases the effects of aerodynamic forces on the disabled thrower (Banja, 2007; Frohlich, 1981; Yu et al., 2002). These studies have contributed to the improvement of training programs of stationary throwers as they provided coaches and athletes with a better understanding of throwing technique as well as strength and fitness requirements (O’Riordan and Frossard, 2006), However, a recent extensive review of literature revealed that although there are many debates on different aspects of the techniques of throwing the discus, the biomechanical studies on this topic for the Paralympians athletes are very limited (Abdelkader, Madani, Adel, et al., 2018; R. M. Bartlett, 1992; Dai et al., 2013; Frossard et al., 2013a; Guebli et al., 2020; Leigh et al., 2010).

The primary reason for the lack of biomechanical studies appears to be due to the complexity of the technique of throwing the discus (Hubbard and Cheng, 2007) for Paralympic athletes. The lack of biomechanical studies on discus throwing (Paralympic) techniques has limited coaches’ and athletes’ understanding of the techniques and appropriate physical and technique training for performance improvement especially in disabled athletes. It may be caused by the different phases of discus throwing between different athlete’s class (Martins Freire et al., 2017; Morriën et al., 2017). Discus throwing is generally divided in five phases; preparation, entry, airborne, transition and delivery (R. Bartlett, 2000; Yu et al., 2002). But this is different for seated throwers of class 57; the performance of elite seated throwers depends on the interaction between the design of the athletes’ throwing frame and their throwing technique (Auriemma and De Luigi, 2018). Most frames feature up to four legs, foot rests, and strapping systems to anchor the athlete to the seat and the frame to the ground. The typical seat area is composed of a flat surface with some form of cushioning that must be no higher than 75 cm from the ground. Athletes are also allowed to use a back-rest, and a pole at their discretion for balance purposes and/or to generate driving forces (Frossard et al., 2005). Thus, the throwing phases may be limited for the seated throwers of class 57 in preparation phase (straddle position, established posture, recovery pre-stretch), preliminary movement or entry phase (> body mid-line twist), power position / delivery or transition phase (max. T-spine/shoulder flexibility, min. Torso tilt, max. Implement radius), and delivery / recovery phase (maintained posture, established block, max. Implement radius, > body mid-line release) (Green, 2012). And these are one of the most likelihood reasons that complicate these studies during analyzing the motor performance aspects in disabled athletes (Abdelkader et al., 2020). Based on our theoretical vision, the analysis of the entire seated throw (firm seat cushion, firm strapping, foot plates, holding bar)

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was subdivided into the following functional phases; 1. Preparation: from the first extension in swing of the throwing hand until the start of entry (athlete will either twist or tilt or twist/tilt torso). 2. Entry: from the maximal extension of the throwing hand during the last swing until the start of transition (best possible body position to execute the delivery phase of the throw). 3. Transition: from last maximal extension of the throwing hand during the last swing until the end of the throw extension in last swing (actual beginning of the throw for create force, and only upper body movements). 4. Delivery: from end of transition until the last picture the hand is in contact with the discus.

Therefore, the present study is an attempt to. continue the work initiated by Guebli.A et al, 2017 through reporting the parameters of the discus trajectory for female gold medal during world-class events, and analyzing the kinetic performance in different Para-athletics classes in this activity. It provides the magnitude of differences in these parameters across classes and genders. As such, the purpose of this paper is to analyze the kinematical variables of discus throw activity in Para-Athletics (Class F57) and their relationships with digital level achievement by an international champion disabled athlete. Hence, the researcher in this study hypothesized that there are kinematical variables in the kinetic performance that influence the level of digital achievement due to the indications of statistical relationships with the digital level achievement.

METHOD

Ethics Committee approval of this study was obtained from Laboratory APS, Society, Education and Health, Faculty of Physical Education and Sports, Hassiba Benboualy University of Chlef, doctorat project Committee (2016/ biomechanics of Physical Activities and Sport).

Sample size: International Paralympic athlete " Saifi Nassima " participated voluntarily in this study. The athlete is two times gold medalist in Paralympic games and three times world champion. Also, she is the world record holder in discus throw class F57. Saifi Nassima (*age: 30 years, height: 1.80 m, weight: 88 kg, type of impairment: limb deficiency, origin of impairment: acquired, club: GSP Alger, best digital level: 34.31 m*) (Nassima Saifi - Athletics | Paralympic Athlete Profile, 2019).

Research Design: For the purposes of analysis, we have calculated the distance of the discus throw in two-dimensional (2D). The athlete throwed the discus with her right arm. Eight attempts of the athlete were recorded and only the best six throws were included in the final analysis. During data collection, recordings were made with two cameras *(AEE MagicCam, 170° view, MOV Format Video, 720p Video Resolution, 120 ips NTFS, Screen Resolution 1280*720 16:9)* where the angle between the optical axes of the two cameras was 90°. The cameras 1 and 2 were placed at distances of 2.8 m on both sides of the throwing circle (side view, rear view) from the thrower and were used to record the kinematic performance during the first and second phases (start and finish throwing) of the discus throw. These two phases (start and finish throwing) in our study were chosen based on the performance characteristics of the Para-athletes class F57 in discus throwing. The analysis of the entire throw in this study was subdivided into the following functional phases: 1. start throwing (entry): from the maximal extension of the throwing hand during the swing until the start of transition. 2. finish throwing (delivery): from end of transition until the last picture; the hand is in contact with the discus. For synching the cameras, all start buttons were linked together electrically by a LANC (CONTROL-L) device to computer (100 Hz). Since the device requires LANC inputs on camcorders or ACC inputs on still cameras, it can be used on some camcorders. Then, the throws were manually synched. The longest official distance thrown was recorded using a

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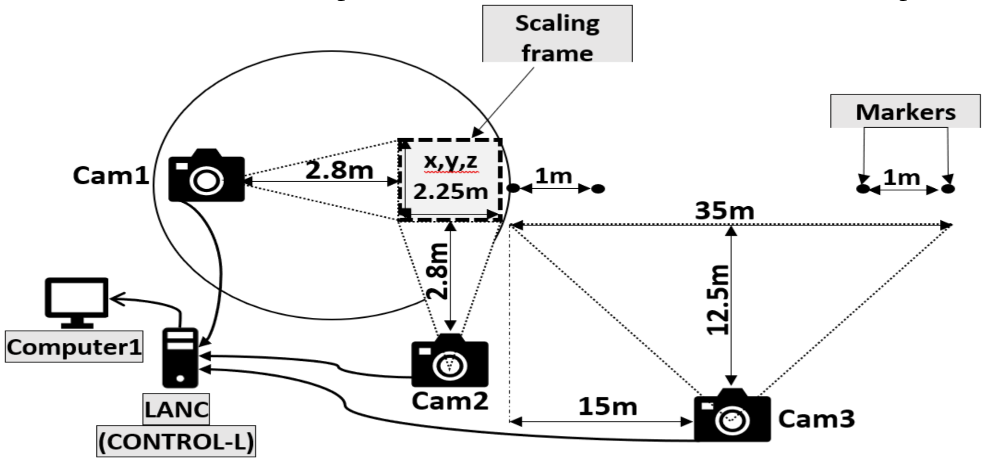
separate camera that was placed at distances of x15 m*z12.5 m from forward of the front edge of the board. All cameras were positioned at y1.5 m in height. To measure the real distance, a series of markers were placed in carefully measured locations along the inside with axes x, y, z 2.25 m reference scaling frame, and the calibration was based on eight reference points for the two cameras (side view, rear view). And four markers were placed along the throwing location on the ground with a x1 m reference scaling for the separate camera. These markers served as reference measurements. The athlete wore reflective markers on eight landmarks to track her motions. Markers were applied on joints of the wrists, the elbows, the shoulders, the hip center, and down the neck with the least possible number of occlusions, to analyze the length and angle of movement by the »x« axis, the height by the »y« axis. The distances of the analysis tests are shown in table 1 for the athlete of the Algerian Paralympic elite. We used dartfish 9 software for the kinematical analysis, it's a video player for sport analysis. It provides a set of tools to capture, slow down, study, compare, annotate and measure technical performances. The films obtained for each try were phases of analysis for each new variable and try.

Kinematic Variables: Based on the similar studies (Abdelkader et al., 2020; Banja, 2007; Banja, T & Tashiro T., 2004; R. M. Bartlett, 1992; Frossard et al., 2013a; Yu et al., 2002), Several variables of the discus throw activity class F57 at start and finish were analyzed and calculated: **1/** The first phase (start throwing), we have the variables; the number of swings (*number*), standby time (*second*), the wrist angle of the throwing hand (*degree°*), cubitus angle of the throwing hand (*degree*°), cubitus angle of the freehand (*degree*°), trunk angle (*degree*°), shoulder angle of the freehand (*degree*°). **2/** The second phase (finish throwing), we have the variables; digital level (*meter*), cubitus angle of the throwing hand (*degree°*), cubitus angle of the freehand (*degree°*), trunk angle (*degree* °), shoulder angle of the throwing hand (*degree*°), head tilt angle (*degree°*), throwing angle (*degree°*), time of throwing (*second*), disk flight time (*second*), shot height (*centimeter*), total performance time (*second*).

Figure 1. The method chosen to capture video of the variables in discus throw performance.



Statistical Analysis: The data analysis procedures used in this study consists of the computation of the means, standard deviations (*SD*), standard deviation error (*Std.E*), minimum and maximum value as descriptive statistics, and the Pearson test for the correlations between all variables identified in similar studies (Abdelkader, Madani, and Bouabdellah, 2018; Benelguemar et al., 2020; Guebli, Bessenouci, et al., 2018; Henni et al., 2020; Zerf Mohammed et al., 2015). We used SPSS (*SPSS for Windows, version 22.0, SPSS Inc. Chicago, Illinois, USA*) statistical program for that statistical analysis of the data obtained.

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RESULTS

Table 1. Description Results of the Algerian World Champion of Discus Throw Class F57 "Saifi Nassima" in the kinematic analysis of his Performance

Variables	Mean ± SD	Std. E	Min/Max	Mean ± SD	Std. E	Min/Max
	Stage I			**Stage Π**		
Digital level	-			33.250± 1.235	0.504	30.870/ 34.050
The number of swings	5.333± 0.516	0.210	5.000/ 6.000	-		
Standby time (s)	6.388± 0.273	0.111	6.200/ 6.810			
The wrist angle of the throwing hand (°)	136.500± 5.205	2.125	126.000/ 139.000			
Cubitus angle of the throwing hand (°)	161.000± 3.687	1.505	154.000/ 164.000	153.500± 3.016	1.231	149.000/ 156.000
Cubitus angle of the free hand (°)	164.000± 2.190	0.894	160.000/ 166.000	52.500± 1.760	0.718	50.000/ 55.000
Trunk angle (°)	22.000± 1.095	0.447	20.000/ 23.000	12.500± 0.836	0.341	12.000/ 14.000
Shoulder angle of the freehand (°)	60.500± 0.836	0.341	59.000/ 61.000	-		
Shoulder angle of the throwing hand (°)	-			90.500± 1.643	0.670	88.000/ 93.000
Head tilt angle (°)				36.666± 1.366	0.557	35.000/ 39.000
Throwing angle (°)				41.480 ± 1.503	.248	39.00 / 42.00
Time of throwing (s)				0.385± 0.013	0.005	0.370/ 0.410
Disk flight time (s)				1.748± 0.024	0.009	1.710/ 1.770
Total performance time (s)				8.521± 0.243	0.099	8.350/ 8.900

Table 1; shows the description results of performance kinematic analysis for our sample "Saifi Nassima" *(the Algerian World Paralympic Champion, Class F57*) in discus throw activity during the first and second stage of performance (*start & finish throwing*), the results explain the values of mean±SD, Std.Error, Minimal and maximal values of variables.

Table 2. The connectivity relationships between variables in order to study in stages of performance (I and Π).

The variables correlated		**Sig. p**	**The variables correlated**		**Sig. p**
Stage i			**Stage π**		
Digital level	Standby time (s)	-.895* .016	Digital level	Cubitus angle of the throwing hand (°)	.864* .027
	Cubitus angle of the throwing hand (°)	.993** .000		Trunk angle (°)	-.872* .023
	Trunk angle (°)	.940** .005		Disk flight time (s)	.939** .005
	Cubitus angle of the freehand (°)	.825* .043		Throwing angle (°)	.995** .000
Number of swings	Cubitus angle of the freehand (°)	-.884* .019		Total performance time (s)	-.900* .014
Standby time (s)	Cubitus angle of the throwing hand (°)	-.916* .010	Shoulder angle of the throwing hand (°)	Cubitus angle of the freehand (°)	.933** .007
Cubitus angle of the throwing hand (°)	Trunk angle (°)	.891* .017	Cubitus angle of the throwing hand (°)	Trunk angle (°)	-.911* .011
Trunk angle (°)	Cubitus angle of the freehand (°)	.833* .039		Disk flight time (s)	.870* .024
	Shoulder angle of the freehand (°)	.873* .023	Trunk angle (°)	Cubitus angle of the freehand (°)	-.882* .020
			Disk flight time (s)	Total performance time (s)	.934** .006

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Table 2. The connectivity relationships between variables in order to study in stages of performance (I and Π) (cont.)

The variables correlated between stage i & stage π					
The number of swings	Cubitus angle of the throwing hand π (°)	-.880* .021	Cubitus angle of the throwing hand i (°)	Cubitus angle of the throwing hand π (°)	.893* .016
	Trunk angle π (°)	.980** .001		Disk flight time (s)	.824* .044
	Cubitus angle of the throwing hand π (°)	-.880* .021		Total performance time (s)	-.824* .044
Standby time (s)	Time of throwing (s)	-.813* .049	Trunk angle i (°)	Cubitus angle of the throwing hand π (°)	.820* .046
	Total performance time (s)	.985** .000		Disk flight time (s)	.939** .005
Cubitus angle of the free hand i (°)	Shoulder angle of the throwing hand π (°)	.907* .013		Throwing angle (°)	-.907* .013
	Trunk angle π (°)	-.898* .015			

**(P<0.05) * Correlation is significant at the 0.05 level.*
*** (P<0.01) ** Correlation is significant at the 0.01 level (1-tailed).*

Table 2; shows the correlation results between kinematic variables for our sample in the first stage i of discus throw (start throwing), and in the second stage π (finish throwing), also between kinematic variables of first and second stage in discus throw.

The significant correlation was observed at p level (1-tailed) and degrees of freedom (n-1) between the values of kinetic performance in the first stage i (start throwing), the correlations are positive significant in; the digital level with cubitus angle of the throwing hand at (p< .001), trunk angle at (p< .005), and with cubitus angle of the freehand at (p< .05). The cubitus angle of the throwing hand with trunk angle, and trunk angle with cubitus angle of the freehand, and shoulder angle of the freehand at (p< .05). The correlations are negative significant in; the number of swings with cubitus angle of the freehand, standby time with cubitus angle of the throwing hand, and digital level with standby time at (p< .05).

The significant correlation was observed at p level (1-tailed) and degrees of freedom (n-1) between the values of kinetic performance in the second stage π (finish throwing), the correlations are positive significant in; the digital level with cubitus angle of the throwing hand at (p< .05), with disk flight time at (p< .005), and with throwing angle at (p< .001). The shoulder angle of the throwing hand with cubitus angle of the freehand at (p< .005). The disk flight time with total performance time at (p< .01). The cubitus angle of the throwing hand with disk flight time at (p< .05). The correlations are negative significant in; the trunk angle with cubitus angle of the freehand and the digital level with total performance time, and with trunk angle at (p< .05). The cubitus angle of the throwing hand with trunk angle at (p< .05).

The significant correlation was observed at p level (1-tailed) and degrees of freedom (n-1) between the values of kinetic performance in the first i and second π stage (start and finish throwing), the correlations are positive significant in; the number of swings with trunk angle π at (p< .005). The standby time with total performance time at (p< .001). Cubitus angle of the freehand i with shoulder angle of the throwing hand π at (p< .05). The cubitus angle of the throwing hand i with cubitus angle of the throwing hand π, and with disk flight time at (p< .05). The trunk angle i with cubitus angle of the throwing hand π at (p< .05), and with disk flight time at (p< .005). The correlations are negative significant in; the number of swings with cubitus angle of the shooting hand π, and with cubitus angle of the throwing hand π at (p< .05). The standby time with time of throwing, the cubitus angle of the freehand i with trunk angle π, the

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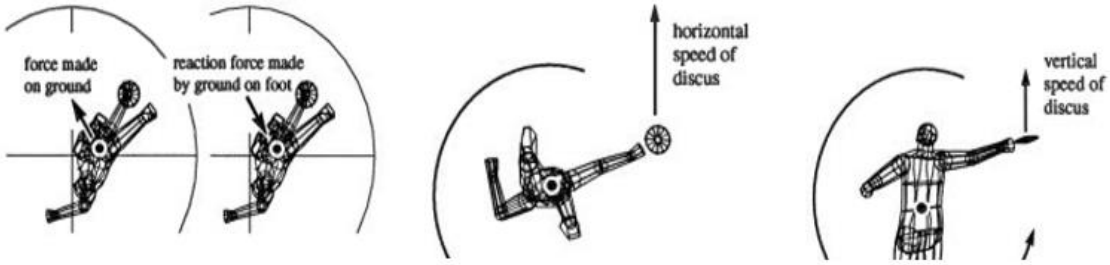
cubitus angle of the throwing hand i with total performance time, and the trunk angle i with throwing angle at (p< .0.05).

DISCUSSION

The goal of this study is to analyze the kinematical variables of discus throw activity in Para-Athletics (*class F57*) and their relationships with digital level achievement. The cubitus angle of the shooting hand, throwing angle, and trunk angle values presented a good correlation with digital level achievement (r=.000, r=.000, r=.005) in the phases of throwing. The most significant correlation value was between the standby time and total performance time (r=.000). It was probably due to the fact that the standby time was not more than 65% from total performance time of throwing during trials in this study, but the best throw happened with a short time in total performance time. Therefore, the increase of angular velocity performance probably affects positively the discus flight time and increases the range (Abdelkader, Madani, Adel, et al., 2018). There is a linear correlation between disk flight time total performance time (r=-.006), and this is an important factor (Frohlich, 1981). These correlations with digital level show that initial discus speed correlates strongly to flight distance by able-body (Leigh & YU, 2007). The angular velocity determines the flight distance when there are few changes from angle and height (Banja, T. and Tashiro T., 2004). This study has found a small variation in time phases of discus throw ; where the release angle of discus (41.480±1.503) presented does not differ much from the values of old able-body throwers papers (Altmeyer et al., 1994; Burke, 1988; Ganslen, 1964; Gregor et al., 1985; Seo et al., 2012), which was probably caused by methodological data treatment problems at that time. It also agrees with evaluation on disabled thrower for the same functional class (Chow and Mindock, 1999). The values are between 35° - 45°. This is a clear indication that the achievement of the ideal angle at the start was good for the athlete. However, this was at the expense of reducing the starting speed. This is not compatible with the integration of all factors of discus throw; which is supposed to launch the disk at the ideal angle and with a very high starting speed, as achieving this good angle with the required speed means that the athlete has made proportional values for each of the horizontal and vertical forces variables. Thus, that will achieve an ideal angle and good starting velocity to achieve the excellent mechanical performance of the throw. On the one hand, it agrees with other recent papers (Abdelkader, Madani, Adel, et al., 2018; R. M. Bartlett, 1992; Frossard et al., 2013b; Leigh et al., 2010) and computational simulations for the kinematic angle values close to this study (Sueyoshi and Maruyama, 1992). On the other hand, these differences in the timing of movement for each athlete indicates the specific characteristics of kinetic performance according to his medical classification and degree, and this causes a discrepancy in the distribution of time along the technical stages of discus throwing.

Figure 2. Describe the performance system in discus throw, forces, horizontal and vertical variables.



Finally, according to our kinematical analysis in discus throw, most basic kinematic variables effective in discus throw techniques of disabled female athletes, are the cubitus angle of the shooting hand, trunk angle, and with cubitus angle of the free hand in the first phase (start throwing), and with cubitus angle of the shooting hand, disk flight time, total performance time,

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and with throwing angle in the second phase (finish throwing) were significant with the digital level achievement. In addition, the kinematic variables in the performance of our sample like cubitus angle of the freehand, shoulder angle of the freehand, disk flight time, were important for effective and supportive for basic variables correlated to digital level achievement. Thus, combining angular motion and arm length to allow for the release speed to be as large as possible. With increase angular motion and the longest possible arm length, the release speed will be at its greatest, allowing for peak performance to occur. As the optimum height, release is seen to be at shoulder height at the point where the discus is leaving the hand, to allow for the discus to reach the highest release speed and the optimum angle of release to be created. The optimum angle of release is individual but is aimed to be between 35 and 45 degrees (Delgado, 2012).

The kinematical analysis of performance is very important for achieving the digital level(Arguz et al., 2021), for that, we need to focus on applying biomechanical principles during kinetic performance (Abdelkader et al., 2021),. It also ensures that the required mechanical position is taken at every stage of performance and in line with the kinetic performance requirements especially for the Paralympic athletes due to their physical and kinetical characteristics, depending on the nature and classification of their disability. Thus, the athletes must limit the values of kinetic performance variables that contribute to achieving the ideal flight path for the disc, by controlling the basic variables in performance, beginning with the extension of the freehand (cubitus angle of the freehand) and the curvature of the trunk (trunk angle), which will directly affect the throwing hand (cubitus angle of the throwing hand), and the angle of throwing. This is a key factor in increasing the timing of flight the disk and the total performance time, bearing in mind that the faster the performance in the throwing stage (time of throwing), the higher, faster the disk will gain (disk flight time).

CONCLUSIONS

This study aims to analyze the kinematical variables of discus throw activity in Para-Athletics (Class F57) and their relationships with digital level achievement. The interpretation of kinetic performance variables is significant to achieve the best digital level of athletes in this class (F57). As a result, we confirm that: 1) The decrease in the variables value of time in throwing phases affects the digital level achievement; in addition, the degree of trunk angle variable. 2) The decrease in the value of throwing angle variable (between 38°- 43°) in second phase of throwing (finish) affects the digital level achievement. 3) The importance of the cubitus angle of the shooting hand appears significantly during the kinetic performance. Thus, we proved, that there are kinematical variables in the kinetic performance that are influenced by the level of digital achievement due to the indications of statistical relationships with the digital level achievement in the stages of throwing discus (cubitus angle of the throwing hand, trunk angle in the first and second stage, standby time, cubitus angle of the freehand in first stage, and disk flight time, throwing angle, total performance time in second stage).

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