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Trunk balance assessment in wheelchair basketball players

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Research Article

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Purpose: The purpose of this study was to assess the trunk balance of people with disabilities who play wheelchair basketball. **Methods:** Sixty-six wheelchair basketball players including 48 with poliomyelitis and 18 with amputation were included in this study. Modified functional reach test, bilateral reach test and lateral reach test were used to assess the trunk balance. In order to determine the norm values of trunk balance, the test results were grouped according to the classification of the patients and mean±standard deviations were calculated. Differences between groups were analyzed with t test. **Results:** No significant difference was found between players with amputation and poliomyelitis in modified functional reach test (p=0.051), bilateral reach test (p=0.108) and Lateral Reach Test (p=0.963) values. The means and standard deviations of trunk balance test values of wheelchair basketball players with poliomyelitis and amputation can be used as preliminary values for establishing trunk balance of wheelchair basketball players. **Conclusion:** These results are helpful and easily understood parameters for classifiers. In the event of increasing the number of participants, these results can provide important norm values for the International Wheelchair Basketball Federation (IWBF) and International Paralympics Committee (IPC).

Key words: Postural balance, Wheelchair basketball, Assessment.

Tekerlekli sandalye basketbol oyuncularında gövde dengesinin değerlendirilmesi

Amaç: Çalışmamızın amacı tekerlekli sandalye basketbol oyuncularının gövde dengelerinin değerlendirilmesiydi. **Yöntem:** Çalışmamıza 48'i poliomyelit ve 18'i ampute olmak üzere toplam 66 tekerlekli sandalye basketbol oyuncusu dahil edildi. Gövde dengesi modifiye fonksiyonel uzanma testi, bilateral uzanma testi ve lateral uzanma testi ile değerlendirildi. Gövde dengesi normal değerlerinin belirlenebilmesi amacıyla test sonuçları her sınıfa göre gruplandırılarak ortalama ve standart sapma değerleri belirlendi. Gruplar arası farklılıklar t testi ile değerlendirildi. **Sonuçlar:** Ampute ve poliomyelitli tekerlekli sandalye basketbol oyuncuları arasında modifiye fonksiyonel uzanma testi (p=0,051), bilateral uzanma testi (p=0,108) ve lateral uzanma testi (p=0,963) değerlerinde istatistiksel açıdan anlamlı fark bulunmadı. Ampute ve poliomyelitli tekerlekli sandalye basketbol oyuncularının gövde dengesi test sonuçlarının ortalama ve standart sapma değerleri tekerlekli sandalye oyuncularının gövde dengelerinin belirlenmesinde bir ön değer niteliği taşımaktadır. **Tartışma:** Elde ettiğimiz sonuçların klasifikerler için anlaşılır ve yardımcı bir parametre olduğunu düşünmekteyiz. Çalışmaya dahil edilen olgu sayısının yükseltilmesi halinde bu değerler Uluslararası Tekerlekli Sandalye Basketbol Federasyonu (IWBF) ve Uluslararası Paralimpik Komite (IPC) için önemli normal değerler oluşturacaktır.

Anahtar kelimeler: Gövde dengesi, Tekerlekli sandalye basketbol, Değerlendirme.

Wheelchair basketball is a fast paced, exciting sport that conforms to the same standards as its stand up counterpart. Unlike most sports for people with disabilities, wheelchair basketball is a team oriented activity that allows athletes with varying degrees and levels of disabilities to participate in an inclusive atmosphere based on a player classification system.[1] Of most importance in an effective functional classification system in wheelchair basketball is the level of trunk function.[1] Lynch et.al defined "sitting balance" as the ability of a person to maintain control over upright posture during forward reach without stabilization.[2] Proximal stabilization to allow distal movements on the one hand and the ability to selectively initiate trunk movements on the other hand has led to the abandoning of the term "sitting balance".[3]

It is very hard to classify many disabled players in an fair way and classification is done to show the relationship between physical activity and level of compatibility. Years of work has been done on classification systems to allow wheelchair basketball players play in equal conditions. There are two methods of classification; medical and functional classification systems.[4] The functional classifier evaluates the function of wheelchair basketball player at training and during game. A personal classification point is given to the player. 4 points of classification is accepted for the first time at 1984.[5] Player classification system aims to use trunk movement levels and stabilization for fair classification.[6]

A half point rule is added to classification system in order to help classifiers. A plus or minus half point can be given to suspicious players. Class 1 player has the maximum level of disability and functional limitation. Class 4,5 player has the minimum disability of all. Class 1 player has significant loss of trunk stability and needs arm support during play. Class 4,5 player can move the trunk in all ways during play. Functional qualification increases through all levels of classification. The system is based on giving every player a chance to play at the game.[5]

The recent decade has seen a demonstrated interest in the classification of wheelchair athletes for participation in sport in a fair and equitable manner.[7] Also many difficulties in functional classification are reported.[5] For these reasons, we aimed to evaluate trunk balances of wheelchair basketball players and identify the norm values of trunk balance for wheelchair basketball players.

METHODS

Participants:

Participants were selected from wheelchair basketball players of Turkish Sport Federation for the Physically Disabled. Having scoliosis, spinal cord injury, spasticity, ankylosing spondylitis, upper extremity deformity, contractures to restrain sitting position and lower than 3 points for manual muscle testing for shoulder muscles were our exclusion criteria for this study. An informed consent form was taken from all participants and ethical approval was taken from Hacettepe University's Ethical Committee. Out of 103 wheelchair basketball players; 31 players because of scoliosis, 2 players because of bullet injury, 3 players because of spinal cord injury and 1 player because of osteogenesis imperfecta were excluded from our study. Forty-eight players with poliomyelitis and 18 players with amputation; in total of 66 wheelchair basketball players were included in our study. Modified functional reach test (MFRT), bilateral reach test (BRT) and lateral reach test (LRT) were used for evaluation of trunk balance.

Modified Functional Reach Test: Players were evaluated in a chair having back support leaning 10° and without arm support. The reason for this 10° back support is to let the players with 3-4.5 points to sit back and relax between trials (Figure 1a). Players with 1-2.5 points were evaluated with a straight back support and a 10° rigid platform placed at seat of chair (Figure 1b). The reason for this is that players with these points are unable to raise their whole trunk from chair's back support. Another reason was to stabilize the pelvis, as this position is also their playing position. Subjects sat in the same position for each trial. Players were positioned as trunk at straight position; hips, knees and ankles positioned

with 90° of flexion and 90° of knee and hip flexion, having 5 cm of clearance between the popliteal fossa and edge of the chair. Measurement tapes were attached to a wall in different heights.[2] Lower extremities were stabilized with a velcro from distal part of femur and the chair is elevated with a raised seat height and feet dangling to extinguish foot support.[8,9] Tape level was arranged as player's shoulder at the level of the acromion. 90° of shoulder flexion was wanted from the player.

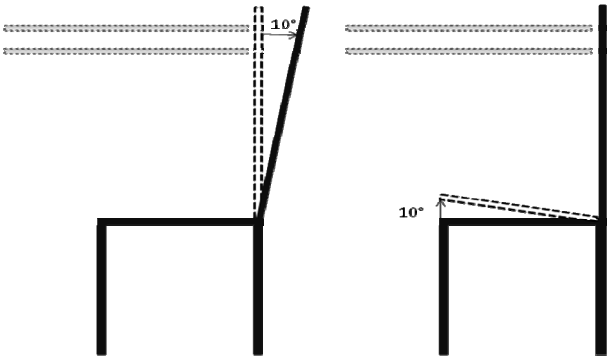

Figure 1. Evaluation mechanism for players with 3-4.5 points (left). Evaluation mechanism for players with 1-2.5 points (right).

The anatomical landmark used to measure reach was the ulnar styloid process. The ulnar styloid process is a prominent landmark and was proximal enough to allow accurate measurements to be taken for all players.[2] Subjects were instructed to reach as far forward as possible without losing balance. This distance was recorded as functional reach.[10] No compensatory activities like shoulder protraction and neck flexion is wanted during forward reach. Subjects were to move as far as possible and hold the terminal position for 3 seconds.[8] The players were guarded for safety and the trial was repeated if the player required assistance to recover. Each player had one practice trial of maximal forward reach, followed by one trial during which data were collected.[2] The dominant upper extremity was used for forward reach. The contralateral hand was placed on the umbilicus, negating any upper extremity compensatory stabilization (Figure 2).[10] a-b)

Figure 2a. Modified Functional Reach Test starting position.

Figure 2b. Modified functional reach test evaluation position.

Bilateral Reach Test: Differently from modified functional reach test, bilateral reach test was tested with 90° bilateral shoulder flexion. Subjects were instructed to reach as far forward as possible without losing balance. This distance was recorded as Bilateral Reach.[10] (Figure 3)

Lateral Reach Test: Differently from modified functional reach test and bilateral reach test, lateral reach test was tested with 90° unilateral shoulder abduction. The anatomical landmark used to measure reach was the ulnar styloid process of dominant extremity. Subjects were instructed to reach as far forward as possible laterally without losing balance. This distance was recorded as Lateral Reach.[9] (Figure 4)

Figure 3. Bilateral reach test.

Figure 4. Lateral reach test.

For players with;

- Class 3.5-4.5; Modified functional reach test, bilateral reach test and lateral reach test.
- Class 2.5-3; Modified functional reach test and bilateral reach test.
- Class 1-2; Modified functional reach test was assessed.

Statistical analysis:

All players were classified for their classification points and mean±standard deviations were calculated. Differences between groups were analyzed using t test. Data were analysed using SPSS 15.0 Statistical Package Programme.

RESULTS

Forty eight players with poliomyelitis and 18 players with amputation; in total of 66 wheelchair basketball players were included in our study. Table 1 shows the demographic and anthropometrical characteristics of wheelchair basketball players.

Table 1. The demographic and anthropometrical characteristics of wheelchair basketball players.

	Poliomyelitis N=48 X±SD	Amputee N=18 X±SD
Age (year)	27.0±5.8	26.6±8.7
Body weight (kg)	59.7±11.1	58.2±17.2
Trunk length (cm)	48.5±5.0	47.2±9.2
Leg length (cm)	41.8±5.9	39.4±14.9
Training year (mo)	57.0±49.9	56.9±48.7

The means and standard deviations of modified functional reach test, bilateral reach test and lateral reach Test values of wheelchair basketball players with poliomyelitis are shown in Table 2 and amputation are shown in Table 3. These values can be used as preliminary values for establishing trunk balance of wheelchair basketball players with poliomyelitis and amputation.

No significant difference was found between players with amputation and poliomyelitis in Modified functional reach test ($p=0.051$), bilateral reach test ($p=0.108$) and lateral reach test ($p=0.963$) values.

DISCUSSION

The means and standard deviations results of modified functional reach test, bilateral reach test and lateral reach test values of wheelchair basketball players with poliomyelitis and amputation for 66 wheelchair basketball players may not be enough to set norm values for trunk balance but can be used as preliminary values for

establishing trunk balance of wheelchair basketball players.

Of most importance in an effective functional classification system in wheelchair basketball is the level of trunk function.[1] Proximal stabilization to allow distal movements on the one hand and the ability to selectively initiate trunk movements on the other hand has led to the abandoning of the term "sitting balance".[3] Unlike most studies about healthy athletes, there are only some studies about injuries of disabled athletes during game.[11] The importance of trunk balance has not been studied and there has not been any study about this subject in literature yet. Because of this reason we planned to assess the trunk balances of wheelchair basketball players.

The recent decade has seen a demonstrated interest in the classification of wheelchair athletes for participation in sport in a fair and equitable manner.[7] Also many difficulties in functional classification are reported.[5] The norm values of trunk balance for each disability type and each classification classes were calculated for wheelchair basketball players. These values are expected to be a helpful parameter for classifiers at players' fair and equal classification. These values can be used as preliminary values for establishing trunk balance of wheelchair basketball players because of the

Table 2. The norm values of trunk balance for wheelchair basketball players with poliomyelitis.

	Modified Functional RT		Bilateral RT		Lateral RT	
Classification point	**n**	**X±SD**	**n**	**X±SD**	**n**	**X±SD**
1.5	5	9.0±5.1	-	-	-	-
2.0	7	17.9±7.1	-	-	-	-
2.5	11	22.5±9.6	11	10.6±4.1	-	-
3.0	6	34.2±21.8	6	34.2±21.8	-	-
3.5	8	28.4±15.8	7	16.6±8.4	5	12.0±4.7
4.0	11	41.9±18.7	11	34.7±20.7	9	31.7±14.2

RT: Reach test.

Table 3. The norm values of trunk balance for amputee wheelchair basketball players.

	Modified Functional RT		Bilateral RT		Lateral RT	
Classification point	**n**	**Min-Max**	**n**	**Min Max**	**n**	**Min-Max**
1.5	1	13-13	-	-	-	-
2.0	2	14-36	-	-	-	-
2.5	2	21-23	2	23-24	-	-
3.0	2	59-93	2	45-93	2	40-70
3.5	7	38±14*	7	21.7±20.2*	7	18.2±6.1*
4.0	4	10-76	4	10-60	4	4-35

RT: Reach test. * Mean±Standard deviation.

minority in number of players evaluated. Maintaining and keeping trunk balance is an important parameter which affects recently discussed functional classification system.

Lynch et.al studied to determine whether the functional reach test could be modified to provide reliable measurements of sitting balance and could be used to measure differences among levels of spinal cord injury. They found test-retest reliability high with modification of the functional reach test and suggested that further study is needed to determine normal values for all levels of lesion.[2] To this end, we aimed to evaluate trunk balances of wheelchair basketball players and identify the norm values of trunk balance for wheelchair basketball players. In case of increasing the number of participants, determination of the norm values of trunk balance is expected.

Okumiya et.al reported that forward reach test distance norm values were 30 cm for elderly.[12] In our study wheelchair basketball players with poliomyelitis showed parallel values as following study (~30-40cm). The reason for this is that poliomyelitis has similar disabilities as senility. Both may have balance disabilities. Although modified functional reach test was tested in sitting position, it has similar values as elderly. The reason for this is that players with poliomyelitis have paralysis on muscle groups. On the other hand, the reason for balance disabilities in players with amputation is the loss of the extremity. In our study, modified functional reach test values of players with amputation are higher than others. The values acquired in our study are parallel to similar studies, which prove us that these tests are suitable for disabled people. In addition, we found that the trunk balance values are quiet similar to the expected values for each class of wheelchair basketball classification as we except the classes 3 and higher have greater trunk balance.

We used a very similar stabilization to wheelchair basketball with a velcro placed at proximal side of femur in order to stabilize the player on the assessment chair during tests. Keer et al used a stabilization of 80% in lower extremities while evaluating forward reach and lateral reach tests in sitting position.[8]

Sprigle et al reported that test-retest reliability of sitting bilateral reach test is 90%.[10] May et al stated that bilateral reach tests are more effective than unilateral reach tests in measuring trunk balance.[13] Considering these statements, three different trunk balance measurement tests (modified functional reach test, bilateral reach test and lateral reach test) were assessed.

Sprigle et al studied to validate 3 clinical measures of reach-functional reach, reach area and bilateral reach against the performance of activities of daily living tasks and stated that while working with clients on seated stability and functional movement, clinicians should be encouraged to incorporate bilateral reach tasks because it has the strongest relationship to activities of daily living performance. Researchers interested in studying postural control and stability during functional tasks should consider using uncompensated reach measures.[10] While their measurements, they put contralateral hand on umbilicus in order to prevent compensatory stabilization.[14] According to this, we warned the players to put their nondominant hand on their umbilicus in abdominal region while three trunk balance tests. We suggest that considering this situation would give more objective data for evaluation of actions while sports.

We found no difference in modified functional reach test, bilateral reach test and lateral reach test results between players with poliomyelitis and amputation. Although measured disabilities are different, no significant difference was found in trunk balance and this leads us to the importance of functional status and functional classification.

The limitation of our study is that we didn't have a specialized group including a biomechanical engineer and we developed a contrivance with our own knowledge. Working with a multidisciplinary team can solve this problem. Because of having no studies about this subject in literature, we hope that this pre-contrivance would be a prototype for further studies. In addition, reliability and validity studies of this protocol must be done by increasing the number of participants.

Contrary to the world, the number of

wheelchair basketball players with poliomyelitis is very high in our country. This situation is not discussed in literature. In addition, there is a difficulty in classification of wheelchair basketball players with poliomyelitis and classifiers are having trouble about making fair decisions. For these reasons, these results are thought to be a helpful and understanding parameter for classifiers. In the event of increasing the number of participants, these results can provide important norm values for IWBF and IPC.

REFERENCES

1. Hedrick B, Brasile F. The relationship of skills of elite wheelchair basketball competitors to the international functional classification system. Therap Rec J. 1996;30:137-148.
2. Lynch SM, Leahy P, Barker SP. Reliability of measurements obtained with a modified functional reach test in subjects with spinal cord injury. Phys Ther. 1998;78:128-133.
3. Verheyden G, Nieuwboer A, Van de Winckel A, et al. Clinical tools to measure trunk performance after stroke: a systematic review of the literature. Clin Rehabil. 2007;21:387-394.
4. Bednarczyk JH, Sanderson DJ. Comparison of functional and medical assessment in the classification of persons with spinal cord injury. J Rehabil Res Dev. 1993;30:405-411.
5. Chen CL, Yeung KT, Bih LI, et al. The relationship between sitting stability and functional performance in patients with paraplegia. Arch Phys Med Rehabil. 2003;84:1276-1281.
6. Malone LA, Gervais PL, Steadward RD. Shooting mechanics related to player classification and free throw success in wheelchair basketball. J Rehabil Res Dev. 2002;39:701-709.
7. Brasile FM. Performance evaluation of wheelchair athletes: more than a disability classification level issue. Adapted Physical Activity Quarterly. 1990;7:289-297.
8. Kerr MH, Eng JJ. Multidirectional measures of seated postural stability. Clin Biomech. 2002;17:555-557.
9. Mudge S, Rochester L, Recordon A. The effect of treadmill training on gait, balance and trunk control in a hemiplegic subject: a single system design. Disabil Rehabil. 2003;25:1000-1007.
10. Sprigle S, Maurer C, Holowka M. Development of valid and reliable measures of postural stability**.** J Spinal Cord Med. 2007;30:40-49.
11. Irwin R, Iversen D, Roy S. Sports Medicine: Prevention, Assessment, Management and Rehabilitation of Athletic Injuries. 2nd ed. Massachusetts, Benjamin-Cummings Pub Co; 1998.
12. Okumiya K, Matsubayashi K, Nakamura T, et al. The Timed "Up and Go" Test and Manual Button Score are useful predictors of functional decline in basic and instrumental ADL in community-dwelling older people. J Am Geriatr Soc. 1999;47:497-498.
13. May LA, Butt C, Minor L, et al. Measurement reliability of functional tasks for persons who self-propel a manual wheelchair. Arch Phys Med Rehabil. 2003;84:578-583.
14. Adegoke BO, Ogwumike OO, Olatemiju A. Dynamic balance and level of lesion in spinal cord injured patients. Afr J Med Med Sci. 2002;31:357-360.