Bhatti Functional Scoring System Versus Other Clinical Scores for the Evaluation of Post-Surgical Reduction of Developmental Dysplastic Hips.

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ABSTRACT

Objective: To determine the accuracy and validity of Bhatti Functional Scoring System (BFSS) for the evaluation of post-surgical reduction of Developmental Dysplastic Hips versus clinical evaluation systems designed by Ferguson and Howarth and McKay's clinical Criteria.

Methods: This cross-sectional study included patients with Developmental Dysplastic Hips operated for open reduction during 1st June 2016 to 30th June 2017 with minimum follow up duration of one year. The study was conducted in Department of Orthopaedic Surgery Paediatric Orthopaedic section at Jinnah Postgraduate Medical Centre (JPMC) Karachi and Neurospinal Cancer Care Institute (NMI Hospital), Karachi Pakistan. The functional outcome was evaluated by Ferguson and Howarth rating system, McKay's Criteria and Bhatti functional scoring system. The parameters compared were time consumed, patient's compliance, difficulties incurred, functional limitations on clinical evaluation and its compatibility with the eastern lifestyle. Post stratification 2/2 table was used to calculate the Kappa statistics and accuracy.

Results: The total number of patients in our study were 48. Male children were 9 (18.8%) and female 39 (88.3%). The mean age was 3 ± 1.45 years(range 2 to 7 years).Excellent outcome was noted in in 87.5%(n=42) patients and good in 6.2%(n=3) patients as per Ferguson Howarth and McKay's criteria while 89.5%(n=43) patients had excellent outcome and 4.1%(n=2) good as per Bhatti scoring system. The compliance for Bhatti Scoring System was excellent to good in 48 (100%) patients and for Ferguson Howarth and McKay's criteria 39 (81.25%) patients had excellent to good compliance. The mean time consumed for calculating the Ferguson and Howarth range of motion index was 6.31 ± 0.92 minutes while for of Bhatti scoring system it was 2.0 ± 0.26 minutes(*P* value <0.05). Bhatti Scoring system was found to be accurate in all patients with validity and cumulative percentage as Kappa 1.00.

Conclusion: The Bhatti Functional Scoring System (BFSS) was less time consuming, patient's friendly and exhibited a more satisfactory compliance. The results were comparable with the Ferguson Howarth rating and McKay's criteria and validated its accuracy.

Keywords: Bhatti's Functional Scoring, Clinical evaluation, Developmental dysplastic hips, open reduction.

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INTRODUCTION

The mainstay of treating Developmental Dysplastic Hips (DDH) in walking age children is based on open reduction, capsulorraphy and facilitated with or without additional pelvic and femoral osteotomies.[1,2] The objective however, is to achieve stable, anatomical, concentric hip with adequate

anterolateral coverage and progressive development of a painless normal hip at the adulthood. The recommended method being the one stage combined procedure to release soft tissue obstacles and correct structural abnormalities of coxa valga anteversa and acetabular obtusity.[1-3] The outcome of DDH treatment are directly proportional to the age at the time of initial treatment and whether unilateral or bilateral DDH.[4-5] To monitor the progressive development of post reduction DDH, various methods of evaluation have been used to know the clinical and radiological outcome. The radiological assessment most commonly used is Severin radiological classification.[6] Whereas for the clinical evaluation multiple criteria has been used by various investigators and these include, Severin's clinical criteria and its modification by Gibson's[6] McKay's criteria and its modification by Barrett and Berkley,[7] Chuinard[8] and Larson's IOWA rating[9] for hip dislocation. The parameters used by these methods are mostly based on the subjective assessment. To make it more objective the Ferguson and Howarth[10] designed Range of Motion (ROM) index by measuring range of motion of the hip joint in degrees all six direction with mathematical calculations. Other systems of evaluation used are Merle d" Aubigne,[11] D'Arcy,[12] and Harris Hip score.[13] Despite having a huge exercise through these scoring systems over the years we found that none of these scoring system was able to evaluate the real functional limitations of the patients while performing daily accustomed sitting habits of eastern lifestyle.

This study was designed to determine the comparative clinical outcome of post-operative DDH on a new scoring system designed by the corresponding author i.e, Bhatti Functional Scoring System (BFSS, Table I)[14] versus commonly practiced method designed by Ferguson and Howarth (FHRS, Table II)[10] and McKay's Criteria (Tables III).[7] We hypothesized that BFSS is superior to FHRS and McKay's criteria in terms of time consumption, compliance, difficulties incurred on performing daily accustomed habits, accuracy, validity and compatibility to eastern lifestyle.

Table I: Bhatti Functional Scoring System (BFSS).[14]

Sitting Habit	Type I	Type II		Type III
Squat (S)	Able to squat comfortably.	Able to squat with heel raised, need support, feel discomfort		Unable to squat.
Palthi (P)	Able to make Palthi comfortably by touching knee to floor.	Able to make Palthi with knee raised from floor for < 45^0, needs support and feels discomfort.		Unable to make Palthi, knee raised from floor over 45^0
Tashahhud (T)	Able to sit in tashahhud easily.	Difficult to sit in tashahhud on floor, feel discomfort. Easy on chair with leg dropped down		Unable sit in tashahhud on floor or Chair with leg dropped down
Score	**Excellent**	**Good**	**Fair**	**Poor**
	SI PI TI (Fig. IA to IC)	SI PII TI SII PI TI (Fig.2.1-2.1C and 2.2A-2.2C)	SII PII TI SII PII TII SII PIII TII (Fig. 3A to 3C)	SIII PIII TII SIII PIII TIII (Fig. 4A to 4C)

Table II: Ferguson and Howarth (FHRS) range of motion Index.[10]

Range of Motion	Multiplying factor
Degree of flexion and abduction	each multiplied by factor 0.4
Degree of adduction and internal rotation	each multiply by factor 0.2
Degree of extension and external rotation	each multiply by factor 0.1
Sum of above 6 range of motion products indicates Cumulative range of motion i.e Ferguson & Howarth Range of Motion Index	
Range of Motion Index	**Cumulative Score**
Excellent	(80-100)
Good	(60-79)
Fair	(44-59)
Poor	Less than 40

Table III: McKay's criteria modified by Berkeleyl for clinical evaluation of results.[7]

Grade	Rating	Description
I	Excellent	Painless, stable hip, no limp, more than 15 degrees of internal rotation
II	Good	Painless, stable hip, slight limp or decreased motion, negative Trendelenburg's sign, more than 15 degrees of internal rotation
III	Fair	Minimum pain, moderate stiffness, positive Trendelenburg's sign
IV	Poor	Significant pain

METHODS

This cross-sectional study was conducted in the Department of Orthopaedic Surgery Paediatric Orthopaedic section at Jinnah Postgraduate Medical Centre (JPMC) Karachi, Pakistan. The Study was conducted after approval by Institutional Review Board and informed consent from the parents of the patients for publication of data and photographs. The study included patients with Developmental Dysplastic Hips (Tonnis height IV) operated for primary open reduction during 1st June 2016 to 30th June 2017 and with minimum follow up postoperative duration of one year. All these patients were operated by the corresponding author at JPMC and Neurospinal Cancer Care Institute (NMI Hospital), Karachi. The sample size was calculated by using WHO sample size calculator taking statistics for accuracy as 90% (Pilot study data) and margin of error as 8.5%. The sample technique included non-probability consecutive sampling. The patient included were of either sex, laterality and age group 18 months to 7 years. The exclusion criteria included septic hip dislocation, teratogenic dislocation, DDH treated with non-surgical treatment, re-dislocated, re-subluxated hips, having post-surgical sepsis and post-surgical avascular necrosis (AVN) of caput femoris.

The clinical outcome was evaluated by Ferguson and Howarth range of motion index, McKay's Criteria[7] and on the Bhatti Functional Scoring System.[14] On evaluation with Bhatti's functional scoring system (table I) the patient is asked to sit in: (i) Squat (crouch sitting), (ii) Palthi (cross legged sitting), (iii) Tashahhud (kneeling). Each sitting Habit is marked as type I, II & III depending on limitations on sitting. The combination of these types is scored as excellent to poor. Patient's Score excellent is indicated with combination of SI + PI +TI (Fig. IA-IC), score good on combination when any type of S, P or T is in Type II component (Fig. 2A-C), score Fair when all types are in Type II and or one of these have Type III component (Fig.3A-C) and score poor when all habits have Type III category (Fig.4A-C). Comparison of Bhatti's functional scoring system (table I & Figures 1-4 ABC) was made with Ferguson and Howarth Range of motion (ROM) index (table II) and McKay's Criteria (table III). The criteria of evaluation include, time consumption, patient's compliance, difficulties incurred, functional limitations on clinical evaluation and its compatibility with the eastern lifestyle. The evaluation parameter for each patient were recorded for BFSS in video and then all three scales parameters numerically recorded in a predesigned proforma. All procedures and information were supervised by the corresponding author.

The data was analyzed by using a statistical software package (SPSS, version 23). Descriptive statistics were computed for age and presented as mean and standard deviation. The percentage and frequency were computed for qualitative variables such as gender and functional outcome of treatment of DDH on FHRS ROM Index, McKay's criteria and BFSS and calculations was made to assess the accuracy between these systems. Kappa value was calculated. Effect modifiers like age and gender were addressed through stratification. Post stratification 2/2 table was used to calculate the Kappa statistics and accuracy. The Kappa values less than 0.2 signifies poor agreement, 0.2 to 0.40 as fair, 0.40 to 0.60 as moderate, 0.60 to 0.80 as good and 0.80 to 1.00 as very good agreement. Data was presented in tables where necessary.

RESULTS

We had a total of 48 children out of which 9 (18.8%) were male and 39 (88.3%) female. The mean age was 3 ± 1.45 years (range 2 to 7 years). The mean duration of post op follow up as 1.74±.9839 years (range 1 to 4.5 years).

Table IV: Over all outcome with all three clinical rating scales.

Ferguson Howarth and McKay's criteria			**Bhatti Functional Scoring system**	
Outcome	Number of patients	Percentage	Number of Patients	Percentage
Excellent	42	87.5	43	89.5
Good	3	6.25	2	4.16
Fair	3	6.25	3	6.25
Total	48	100.00	48	100.00

The functional outcome with FFRS and McKay's Criteria was 93.75% excellent to good that was equal to scoring with BFSS (Table IV). The kappa value calculated according to gender was 0.557 which revealed a moderate level of agreement. Considering compliance to the Bhatti's Scoring System, 48

(100%) patients had excellent to good compliance while for Ferguson Howarth and McKay's criteria, 39 (81.25%) patients had excellent to good compliance. The mean time spent for calculating the Ferguson and Howarth range of motion index was 6.3 ± 0.92 minutes, while in case of Bhatti's scoring system, it was 2.0± 0.206 minutes. The difference in time was found to be statistically significant. (*P* value <0.05). Bhatti's Scoring system was found to be accurate in all patients with validity and cumulative percentage as Kappa 1.00.

DISCUSSION

Although the evaluation of postsurgical reduction of DDH has been done by varied clinical and radiological tools in literature,[6-12] none of the clinical evaluation tools reflects the limitations exhibited by the patients while performing accustomed daily sitting habits of Eastern lifestyles. To overcome this shortfall in clinical evaluation of DDH after surgical reduction the corresponding author designed Bhatti Functional scoring system that deemed fit with eastern lifestyle.[14]

The Bhatti Functional Scoring system (table I) demonstrates the functional activities and limitation exhibited by the patient while performing daily accustomed sitting habits of eastern community lifestyle. It is less time consuming, easy to perform and video recorded with a significant ease. Since the personnel physical contact of the interpreter is minimum while video recording the patient usually exhibits a good compliance with BFSS. The video recording provides an error free re-evaluation and a single person can evaluate the record. Whereas evaluation with Ferguson & Howarth (table II), McKay's clinical criteria (table III) and other assessment tools[7-10] the video recording of findings with each ROM and parameter becomes very cumbersome, time consuming, needs an assistant to record and patient exhibit apprehension as well.

Although Ferguson and Howarth ROM index made the clinical assessment of postoperative hip more objective[10] yet the parameters used are more cumber-some, time taking and need measurements of exact degree of ROM in all six directions of the hip joint and then a mathematical calculation (table II). This makes its application to paediatric patients at times very difficult as it is performed on the lying position with a physical contact of the examiner creating apprehension and poor compliance in young children. The McKay's criteria include subjective assessment with complaints of pain, limp, stiffness, stability and an objective assessment with Trendelenburg's sign and measurement of the internal rotation.[7] None of these two and other clinical rating scales exhibit patients' limitations on performing daily accustomed sitting habits as observed in our community. The Bhatti's functional scoring system however, suits better to evaluate our patients for their postsurgical limitations and adoptability to their normal eastern lifestyle. The BFSS not only depicts subjective assessment of patient's performance, endurance and discomfort but to a better extent an objective assessment of range of motion of the postoperative hip as well. The ROM with BFSS is assessed while patients sit in all three positions of Squat, Palthi and Tashahhud. The squat denotes complete flexion, comfortable abduction (25^0-30^0) and mild external rotation (15^0-20^0) at the hip joints. This signifies comfort in daily accustomed habits for which parents are often worried if a child is not able to do so (Fig, 1A). The Palthi denotes bilateral FABER test in sitting i.e. the hip in flexion 90^0-100^0 degree, abduction 45 degree and complete external rotation at hip joints. (Fig. 2A). The Tashahhud (kneeling) denotes, hip flexed to 90^0, external rotation 5^0-10^0 degree and comfortable abduction 5^0-10^0. (Fig. 3A). The rating of BFSS as excellent to poor is made on combination of all three sitting types (Table I)

Amongst the above mentioned clinical evaluation tools,[7-13] the McKay's criteria[7] been widely used by authors including the corresponding author in his previous publications.[16-19] Bhatti A and colleagues in their 4 reports[16-19] achieved 70% to 94% excellent to good outcome with one stage open reduction of DDH in walking age children as per Ferguson & Howarth rating, McKay's and its modified scores and Severin clinical scorings. These results by Bhatti A significantly match with studies by Abdullah El Sayed of Egypt and Bajuifer of Saudia.[20-21]The current report however, revealed 94% excellent and good on Ferguson Howarth and McKay's criteria and on BFSS evaluation. These results are also comparable with other studies.[1-3,21,22,25]

In our opinion comparing the results using McKay's criteria with BFSS the results with BFSS seemed to be more realistic than FHRA and McKay's criteria because evaluation seemed exaggerated with the latter as performed passively in lying position instead an active evaluation of sitting habits. This difference seemed to be due to repeated video-based evaluation of the patients as assessed with BFSS whereas with Ferguson Howarth and McKay's criteria the authors relied on outcome recorded numerically in the proforma.

The time spent on BFSS[14] was much less than to calculate the Ferguson, Howarth range of motion and McKay's criteria.[10] Similarly compliance was also observed to be good to excellent in case of BFSS as patients themselves actively made the positions of sittings without apprehension as patients were away from the doctor and it took about a minute or two to complete the assessment. The results were also comparable with the Ferguson Howarth rating and McKay's criteria having same accuracy. Whereas the compliance of patients to Ferguson Howarth rating and McKay's criteria remained fair to good because of apprehension of evaluator's physical contact which itself is a time taking procedure and involves mathematical calculation of the results.

One limitation of our study could be the intra-observer bias as the evaluation was done by the designer of the BFSS and his colleagues. The other limitation was the short duration of follow up. Further studies are therefore recommended to verify the usefulness of BFSS.

CONCLUSION

The Bhatti Functional Scoring System (BFSS) was less time consuming, patient's friendly and exhibited a more satisfactory compliance. The results were comparable with the Ferguson Howarth rating and McKay's criteria that validate its accuracy. The parameters of evaluation introduced in this new functional scoring system were significantly compatible with the eastern life style. They provide a real time information regarding patient's limitations in performing daily accustomed sitting habits for which every parent shows a concern.

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Figure IA to IC: Left DDH, Post reduction radiological Severin's class I, sitting habit types: Squat I, Palthi I and Tashahhud I, that suffice with BFSS score Excellent.

Figure 2.1A to 2.1C: Bilateral DDH, Post reduction radiological Severin's class II, sitting habit types: Squat I, Palthi II, Tashahhud I, that suffice with BFSS score Good.

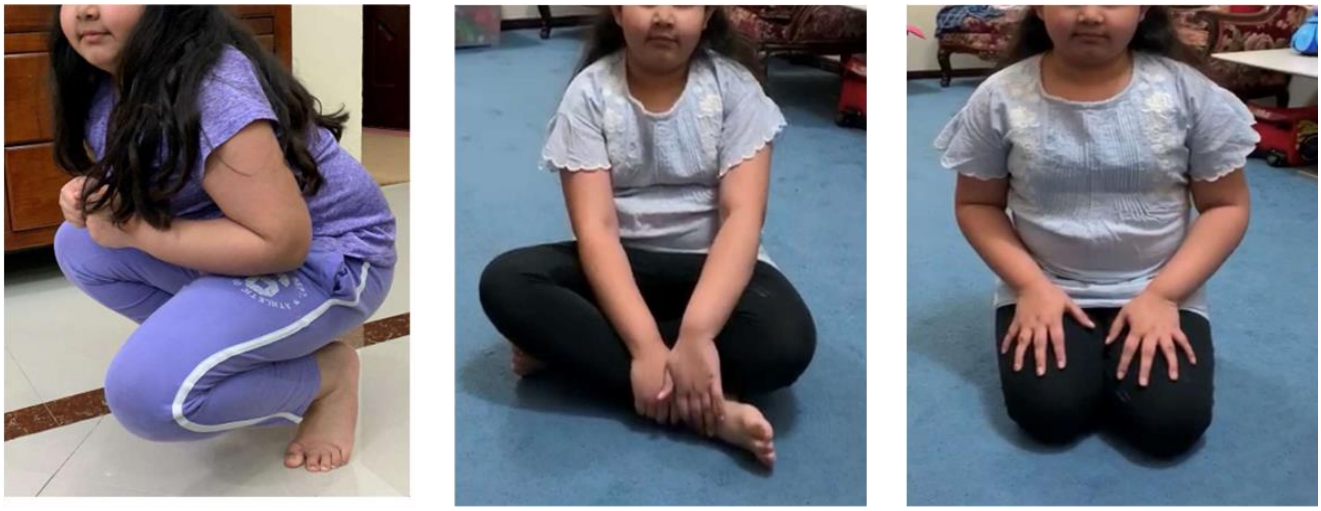

Figure 2.2A to 2.2C: Left DDH, Post reduction radiological Severin's class II, sitting habit types: Squat II, Palthi I, Tashahhud I, that suffice with BFSS score Good.

Figure 3A to 3C: Left DDH, Post reduction radiological Severin's class III, sitting habit types: Squat II, Palthi II, Tashahhud I, that suffice with BFSS score Fair.

Figure 4A: Bilateral DDH, Post reduction radiological Severin's class IVA. **Fig 4B and 4C:** Severin's radiological Severin's class III, sitting habit types: Squat III, Palthi III, Tashahhud III: that suffice with BFSS score Poor.

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