ORIGINAL ARTICLE

Correlation between Harris, modified Harris hip, and Oxford hip scores of patients who underwent hip arthroplasty and hemiarthroplasty following hip fracture

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ABSTRACT

BACKGROUND: Harris hip score (HHS), modified HHS (MHHS), and Oxford hip score (OHS) were designed to determine the functional outcomes after primary total hip arthroplasty (THA). The aim of this study was to evaluate the correlation between MHHS, HHS, and OHS in different populations of arthroplasty such as primary THA, revision THA, THA for Crowe Type IV developmental dysplasia of the hip (DDH), and hip hemiarthroplasty (HA).

METHODS: A total of 399 patients (254 females and 145 males) that included 128 cases of primary THA, 36 of revision THA, 200 of HA, and 35 of THA with femoral shortening osteotomy with a minimum of 24 months of follow-up were included. HHS, MHHS, and OHS were calculated for each patient and the correlation between theses scores was evaluated for each subgroup.

RESULTS: The overall mean age was 67.5±14.3 years. The mean HHS, MHHS, and OHS were 74.9±17.9, 75.7±18.7, and 38.7±12.5, respectively. A very strong correlation was observed between HHS and MHHS (r=0.995, p=0.000) as well as between HHS and OHS (r=0.845, p=0.003) in the general study population. In subgroup analysis, there was a very strong correlation between HHS and MHHS in primary THA, revision THA, THA in hip HA, and Crowe Type IV DDH groups (r=0.984, p=0.000; r=0.977, p=0.000; r=0.984, p=0.000; and r=0.995, p=0.000; respectively). However, there was a significant correlation between HHS and OHS in these groups except revision THA group (r=0.851, p=0.023; r=0.587, p=0.069; r=0.989, p=0.002; and r=0.965, p=0.000; respectively).

CONCLUSION: This is the first study to investigate the usefulness of MHHS and OHS in hip HA and THA in patients with Crowe Type IV DDH. Our findings suggest that MHHS and OHS are useful for evaluating functional outcomes with HA, primary and revision THA, and THA with femoral shortening osteotomy for Crowe type IV DDH.

Keywords: Correlation; Crowe Type IV developmental dysplasia of the hip; Harris hip score; hemiarthroplasty; modified; range of motion.

INTRODUCTION

Total hip arthroplasty (THA) is the gold standard treatment for end-stage hip osteoarthritis.[1,2] Historically, THA was reserved for older patients; however, in the last decade, indications for THA have been expanded.[3] The annual incidences of primary and revision total hip arthroplasties are expected to increase due to the aging of the population.[4] Although THA can be a successful surgery with advanced component designs, more than 50,000 patients undergo revision hip arthroplasty in the USA each year.[5] The incidence of revision THA is expected to increase in the subsequent decades.[6]

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The main indication for hip hemiarthroplasty (HA) is hip fractures in elderly population. The incidence of hip fractures is higher in the aging population and that of hip HA is expected to increase overtime.[7]

It is important to document patient satisfaction and the functional status after any type of surgery. There are multiple scoring systems available to measure the functional outcomes after THA, such as Harris hip score (HHS), Oxford hip score (OHS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and hip disability and osteoarthritis outcome (HOOS).[8,9] The HHS has been used for many hip pathologies, such as pertrochanteric fractures, intracapsular femoral neck fractures, impingement syndrome, and cases of revision surgeries.[10] However, it is the most popular, validated, and well-accepted scoring system to evaluate the post-operative functional status following THA.[11] The OHS was introduced in 1996 as an instrument to quantify a patient's disability associated with disorders of the hip. The scoring system has been validated in several studies. However, there is a paucity of published data on the normal ranges of pre- and post-operative Oxford scores.[12,13]

HHS aids in evaluating both pain and abilities of daily living as well as limitations of hip function by assessing the range of motion.[14] Modified Harris hip score (mHHS) questionnaire does not include the hip range of motion and deformity domains.[15] It mainly focuses on the pain and functional status of the patient. mHHS was introduced by Byrd and Jones in 2000 to postoperatively evaluate patients who underwent hip arthroscopy.[16] Subsequently, it has been widely used in hip arthroscopy. Kemp et al.[17] demonstrated that MHHS has good reliability and adequate validity in patients at 12–24 months after hip arthroscopy. MHHS is a simpler and easier test than HHS and is more practical for clinicians, especially in busy clinics.

Edwards et al.[18] suggested that the evaluation of the range of motion may not be necessary after primary or revision THA; they concluded that MHHS is enough to estimate the functional status in that population. There are few studies in which the usefulness of MHHS in other hip pathologies, such as THA in dysplastic hips and pertrochanteric hip fractures, has been evaluated.[19] To the best of our knowledge, there has been no study in which the correlation between HHS and MHHS has been investigated in patients with hip HA and THA in Crowe Type IV developmental dysplasia of the hip (DDH). The aim of this study was to evaluate the correlation between HHS, MHHS, and OHS in different populations of patients undergoing hip arthroplasty including primary THA, revision THA, THA for Crowe Type IV DDH, and hip HA.

MATERIALS AND METHODS

This research has been approved by the IRB of the authors' affiliated institutions. This study has been performed in accordance with the 1964 Declaration of Helsinki and its later updates. After approval by the Institutional Review Board, data of patients who underwent hip HA and THA in our institution between April 2012 and November 2017 were collected. The inclusion criteria were primary THA, revision hip arthroplasty, or hip HA after femoral neck or intertrochanteric fracture and THA with femoral shortening osteotomy for Crowe Type IV DDH with a minimum follow-up of 24 months. Patients with ipsilateral or contralateral neurological deficits, post-traumatic osteoarthritis, and rheumatological diseases were excluded from the study. Overall, 16 patients died during the post-operative period and nine patients refused to participate in this study. The parameters of the last surgery were recorded in 37 patients who underwent bilateral surgeries. After exclusion, a total of 399 patients (200 hip HA, 128 primary THA, 36 revision THA, and 35 THA for Crowe Type IV DDH) were included into the study. All patients were operated at a single center through the posterolateral approach. The demographic data of the patients were recorded, and HHS, OHS, and MHHS were calculated by a blinded observer, who did not know the study protocol at the last follow-up. Subsequently, the correlations between HHS, OHS, and MHHS were evaluated in all patients, as well as in the subgroups undergoing hip HA, primary THA, revision THA, and THA for Crowe Type IV DDH. HHS and OHS used in the study were translated, culturally adapted, and validated to Turkish language previously (Translation, cross-cultural adaptation, and validation of the Turkish version of the HHS.[20] Cross-cultural adaptation and validation of the Turkish version of OHS).[21] MHHS is a simplified version of HHS, when only the patient-reported outcomes portion of the HHS is completed, it is referred to as a MHHS. Therefore, MHHS questionnaire contains same questions with HHS and only difference is the lack of deformity and range of motion examination. Results of descriptive analyses are presented in the form of mean, standard deviation, median, minimum and maximum values, frequency, and ratio values. The normality of the variables was assessed using the Kolmogorov–Smirnov test. Spearman's correlation analysis was used to determine the relationship between the two scores. $P<0.05$ was considered statistically significant. All statistical analyses were performed using SPSS for Windows, version 22 (IBM Corp., Armonk, NY, USA).

RESULTS

This study included 399 patients; 254 patients were female (63.7%) and 145 were male (36.3%). The mean age was 67.5±14.3 years. There was a very strong correlation between HHS and MHHS independent of the type of surgery when all the patients were analyzed together ($r=0.995$, $p<0.001$). Nevertheless, a positive correlation between HHS and OHS was detected independent of the type of surgery too ($r=0.845$, $p=0.003$) (Table 1).

The primary THA group included 128 patients – 90 (70.3%)

Table 1. Correlation between HHS, MHHS and OHS in the study population

	Min-Max	Median	Mean±SD	r (95% CI)	p
Harris hip score	13.1–100.0	80.0	74.9±17.9		
Modified Harris hip score	13.2–100.1	75.0	75.7±18.7	0.995 (0.993–0.997)	0.000
Oxford hip score	9.8–48.0	38.0	38.7±12.5	0.845 (0.813–0.988)	0.003

R: Spearman correlation coefficient. HHS: Harris hip score; MHHS: Modified Harris hip score; OHS: Oxford hip score; SD: Standard deviation; CI: Confidence interval.

Table 2. Correlation between HHS, MHHS and OHS in primary THA population

	Min-Max	Median	Mean±SD	r (95% CI)	p
Harris hip score	60.0–99.0	88.0	87.7±6.5		
Modified Harris hip score	58.0–91.0	90.2	89.1±6.2	0.984 (0.980–0.988)	0.000
Oxford hip score	17.76–43.2	44	43.1±5.3	0.851 (0.780–0.820)	0.023

R: Spearman correlation coefficient. HHS: Harris hip score; MHHS: Modified Harris hip score; OHS: Oxford hip score; THA: Total hip arthroplasty; SD: Standard deviation; CI: Confidence interval.

Table 3. Correlation between HHS, MHHS and OHS in revision THA population

	Min-Max	Median	Mean±SD	r (95% CI)	p
Harris hip score	62.0–94.0	78.5	79.4±7.3		
Modified Harris hip score	60.5–95.7	80.3	80.5±7.4	0.977 (0.973–0.981)	0.000
Oxford hip score	29.5–46.1	40.8	40.9±5.6	0.587 (0.345–0.578)	0.069

R: Spearman correlation coefficient. HHS: Harris hip score; MHHS: Modified Harris hip score; OHS: Oxford hip score; THA: Total hip arthroplasty; SD: Standard deviation; CI: Confidence interval.

Table 4. Correlation between HHS, MHHS and OHS in hemiarthroplasty

	Min-Max	Median	Mean±SD	r (95% CI)	p
Harris hip score	13.1–100.0	65.2	65±19.1		
Modified Harris hip score	13.2–100.1	66.0	65±20.0	0.995 (0.992–0.998)	0,000
Oxford hip score	7.2–47.0	32.4	32.1±11.9	0.989 (0.854–0.853)	0.002

R: Spearman correlation coefficient. HHS: Harris hip score; MHHS: Modified Harris hip score; OHS: Oxford hip score; SD: Standard deviation; CI: Confidence interval.

females and 38 males (29.7%). The mean age was 59.4±11.1 years. There was a very strong correlation between HHS and MHHS (r=0.984, p<0.001) in this group and positive correlation between HHS and OHS, respectively (r=0.851, p=0.023) (Table 2).

The mean age was 59.4±10.0 years in the revision THA group. There was a very strong correlation between HHS and MHHS (r=0.977, p<0.001) in this group, however, no significant correlation was detected between HHS and OHS (r=0.587, p=0.069) (Table 3).

In the hip HA group, the mean age was 77.5±8.0 years. There was a very strong correlation between HHS and MHHS (r=0.995, p<0.001) in this group. Besides that, significant correlation was detected between HHS and OHS (r=0.989, p=0.002) (Table 4). The distribution of HHS and mHHS in this group is illustrated in Figure 1.

The Crowe type IV DDH group included 35 patients – 25 (71.4%) females and 10 (28.6%) males. The mean age was 47.9±12.2 years. There was a very strong correlation between HHS and MHHS in this group as well (r=0.984, p<0.001) and

Table 5. Correlation between HHS, MHHS and OHS in THA in Crowe Type 4 DDH population

	Min-Max	Median	Mean±SD	r (95% CI)	p
Harris hip score	42.0–93.0	82.0	79.7±11.9		
Modified Harris hip score	44.0–95.7	85.8	82.6±11.9	0.995 (0.990–1.000)	0.000
Oxford hip score	20.8–47.7	38.5	38.6±11.7	0.965 (0.877–0.986)	0.000

R: Spearman correlation coefficient. HHS: Harris hip score; MHHS: Modified Harris hip score; OHS: Oxford hip score; THA: Total hip arthroplasty; DDH: Developmental dysplasia of the hip; SD: Standard deviation; CI: Confidence interval.

Table 6. Correlation of MHHS and OHS values stratified by operation groups

	r (95% CI)	p
Primary THA	0.997 (0.993–0.997)	0.000
Revision THA	0.988 (0.978–0.991)	0.000
Hemiarthroplasty	0.889 (0.879–0.912)	0.013
Crowe type 4 DDH	0.996 (0.983–0.995)	0.012

R: Spearman correlation coefficient. MHHS: Modified Harris hip score; OHS: Oxford hip score; THA: Total hip arthroplasty; DDH: Developmental dysplasia of the hip; CI: Confidence interval.

strong correlation between HHS and OHS was recorded (r=0.965, p=0.000) (Table 5). Figure 2 illustrates the distribution of HHS and MHHS in this group.

Table 6 shows the correlation between mHHS and OHS for different operation types. There was a strong correlation between mHHS and OHS in all operation groups (p<001) (Table 6).

DISCUSSION

The most important finding of this study was a very strong correlation between HHS and MHHS in patients who underwent THA, revision THA, THA with femoral shortening osteotomy for Crowe type IV DDH, and hip HA. Nevertheless, OHS appeared to be correlated with HHS in all these groups except for revision THA. Based on our results, MHHS and/or OHS can be used as a simpler and time-saving tool in patients who undergo THA for Crowe type IV DDH and hip HA.

The optimal scoring system for measuring the outcomes following hip arthroplasty has remained controversial.[22] Numerous surgeons have previously suggested the use of the HHS, Western Ontario McMasters Arthritis Index, and OHS.[13] One of the most commonly used scoring systems after THA is HHS.[14] MHHS is a simple modification of HHS without the deformity and range of motion assessments. On this scale, the maximum score is 100; therefore, it is easy to analyze the results.[16] Edwards et al.[18] suggested that using MHSS instead of HHS is adequate for determining functional outcomes after primary and revision THA. Recent studies related to primary or revision THA have reported their results with MHHS,[23,24] which appears to be more practical than HHS and may help save the surgeon's time in an outpatient clinic. In the present study, there was a very strong correlation between HHS and MHHS in both, primary and revision THA. Our findings concur with those in literature that have demonstrated the usefulness of mHSS in patients who underwent primary or revision THA.

The ideal assessment of hip function would involve an easy to administer, comprehensive, valid, and reliable scoring sys-

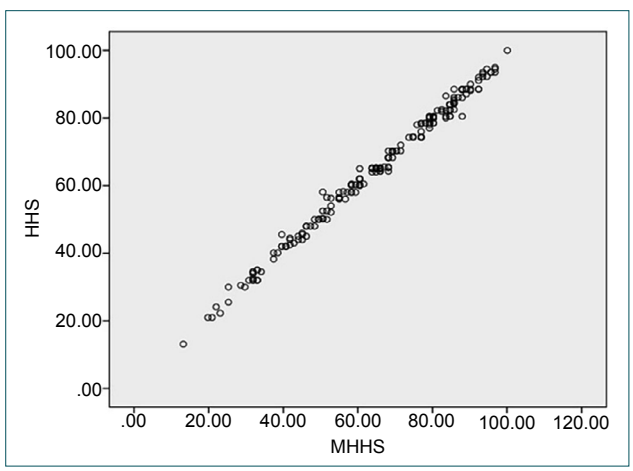

Figure 1. Correlation between Harris hip score (HHS) and modified HHS in hemiarthroplasty group.

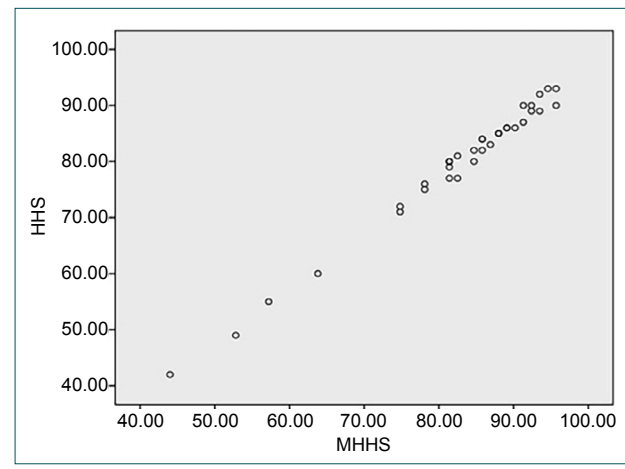

Figure 2. Correlation between Harris hip score (HHS) and modified HHS in total hip arthroplasty with Crowe Type 4 developmental dysplasia of the hip.

tem. There is good evidence to support the validity of the OHS in many settings.[13,25] This was confirmed by Parsons et al.[26] who showed good face validity between OHS and HHS; median scores of both measures for this population were approximately at the 95th percentile point of the full scale. Our study showed similar results with literature in that significant correlation was detected between HHS and OHS in all subgroups except for that undergoing revision THA.

The comparable figure from the analysis by Parsons et al.[26] for a somewhat larger population of 149 patients with a median follow-up of 6 years after resurfacing arthroplasty was −0.70 ($p<0.001$). The excellent agreement between these figures from two centers studying populations after different surgical procedures suggests that the association between these scores is clear, consistent, and predictable, and more widely applicable to other scenarios where OHS and HHS are used to assess hip function. This strong and consistent correlation between OHS and HHS further strengthens the case for the use of the Oxford questionnaire, which by not requiring a clinical visit or physical evaluation, will generally have higher compliance and reduced clinic times, consequently lowering associated costs than the HHS.

Many studies have reported the clinical results of patients who underwent HA using HHS.[27,28] Frihagen et al.[29] compared HHS, Euro-Qol-5d, and Barthel Index and found that HHS demonstrated better discriminatory ability and responsiveness to determine the outcome following femoral neck fractures. Zhang et al.[30] and Skinner et al.[31] used MHHS to determine the outcomes in patients who underwent HA. However, the usefulness of MHHS in those patients has not been investigated. In our study, the correlation between HHS and MHHS in patients who underwent HA was found to be very strong. Therefore, MHSS is a reliable scale to determine the outcomes following hip HA.

Total hip replacement for Crowe Type IV DDH is a complex procedure and remains a challenge for orthopedic surgeons, especially in the developing countries.[32] To the best of our knowledge, no study has evaluated the post-operative functional outcomes using MHHS in patients who underwent THA and femoral shortening osteotomy in patients with Crowe Type IV DDH. Almost all publications have used HHS to determine the functional outcome score in patients with Crowe Type IV DDH who underwent THA.[32] Limb length discrepancy is one of the most important outcomes after THA in patients with Crowe Type IV DDH. Unlike HHS, MHHS does not include limb length discrepancy; however, this difference did not affect the very strong correlation level between those two scales in our study.

To the best of our knowledge, this is the first study to evaluate the usefulness of MHHS in patients with Crowe Type IV DDH who underwent HA and THA. Based on our findings, we can suggest the use of MHHS to determine the functional outcomes in these subgroups as well as patients who undergo primary or revision THA.

There are several limitations of this study. First, limitation was that we included heterogeneous populations with unequal number of patients in the subgroups. Second, the retrospective design of the study may have resulted in selection bias. Third, only HHS was used as the reference assessment of the functional outcomes. Additional correlation of MHHS and OHS with other accepted scoring systems such as WOMAC, Short Form-36, and hip disability and osteoarthritis outcome score could increase the understanding of the usefulness of MHHS.

Conclusion

A very strong correlation was found between HHS, MHHS, and OHS in patients with Crowe Type IV DDH who underwent primary, revision, partial, and total hip arthroplasties. MHHS and OHS can be used as a practical and time-saving tool in the assessment of the functional outcomes in various hip arthroplasty populations regardless of the variables, including primary, revision, dysplastic, and HA. Our findings may guide future studies in the evaluation of the strength of MHHS and OHS in different hip arthroplasty populations.

Ethics Committee Approval: This study was approved by the Uludag University Faculty of Medicine Ethics Committee (Date: 08.07.2020, Decision No: 2020-12/14).

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Authorship Contributions: Concept: T.B.K.; Design: T.B.K.; Supervision: T.B.K.; Resource: S.O., M.Ö., E.U.; Data: S.O., M.Ö., E.U.; Analysis: T.B.K., G.E., S.O.; Literature search: T.B.K., G.E., S.O.; Writing: G.E., M.Ö., E.U.; Critical revision: A.M.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Kalça artroplastisi ve kalça kırığı sonrası hemiartroplasti yapılan hastalardaki Harris, Modifiye Harris ve Oxford Kalça skorlarının korelasyonu

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AMAÇ: Harris Kalça Skoru (HKS), Modifiye HKS (MHKS) ve Oxford Kalça Skorları (OKS) primer total kalça protezi sonrası fonksiyonel sonuçları değerlendirmek için tasarlanmıştır. Bu çalışmanın amacı, primer total kalça protezi, revizyon total kalça protezi, Crowe 4 gelişimsel kalça displazisi sonrası total kalça protezi ve kalça kırığı sonrası hemiartroplasti uygulanan hastalarda HKS, MHKS ve OKS skorlarının korelasyonunu değerlendirmektir.
GEREÇ VE YÖNTEM: Üç yüz doksan dokuz hastanın (254 kadın, 145 erkek) 128'i primer total kalça protezi, 36'sı revizyon total kalça protezi, 200'ü kalça kırığı sonrası hemiartroplasti ve 35'i femoral kısaltma osteotomisi ile total kalça protezi idi ve minimum 24 ay takip edildi. Her bir hasta için HKS, MHKS ve OKS skorları hesaplandı ve aralarındaki korelasyonları analiz edildi.
BULGULAR: Tüm hastaların ortalama yaşı 67.5±14.3, ortalama HKS, MHKS ve OKS skorları ise 74.9±17.9, 75.7±18.7 and 38.7±12.5 idi. Tüm popülasyonda HKS ve MHKS arasında güçlü bir korelasyon mevcut idi (r=0.995, p=0.000). Aynı şekilde HKS ve OKS arasında (r=0.995, p=0.000) ve HKS ve OKS arasında da (r=0.845, p=0.003) güçlü bir korelasyon mevcut idi. Altgrup analizlerinde primer total kalça protezi, revizyon total kalça protezi, kalça kırığı sonrası hemiartroplasti ve femoral kısaltma osteotomisi ile total kalça protezi gruplarında da HKS ve MHKS arasında güçlü bir korelasyon saptandı (r=0.984, p=0.000; r=0.977, p=0.000; r=0.984, p=0.000; r=0.995, p=0.000). HKS ve OKS arasında da revizyon kalça protezi dışındaki alt gruplarda anlamlı korelasyon saptandı (r=0.851, p=0.023; r=0.587, p=0.069; r=0.989, p=0.002; r=0.965, p=0.000).
TARTIŞMA: MHKS ve OKS arasındaki korelasyonu değerlendiren ilk çalışma olmuştur. Bulgularımız hemiartroplasti, primer ve revizyon kalça protezi ve femoral kısaltmalı kalça protezi sonrası fonksiyonel sonuçların değerlendirilmesinde MHKS ve OKS'nin kullanışlı skorlama olduğunu gösterdi.
Anahtar sözcükler: Crowe tip 4 GKD; eklem hareket açıklığı; Harris kalça skoru; hemiartroplasti; korelasyon; modifiye.

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