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Correlation of basic motor skills with arthroscopic experience

Temel motor becerilerin artroskopik deneyim ile ilişkisi

Mustafa KARAHAN,[1] Pemra C. UNALAN,[2] Sinan BOZKURT,[3] Ilhan ODABAŞ,[3] Umut AKGUN,[4] Serap CIFCILI,[2] Philip LOBENHOFFER,[5] Ahmet Turan AYDIN[6]

Marmara University School of Medicine, [1]Department of Orthopedics and Traumatology, [2]Department of Family Medicine and Clinical Skills Laboratory; [3]Marmara University School of Athletic Education; [4]AOrthopedic Surgeon, Acibadem Kozyatağı Hospital Ortopedi ve Travmatoloji Kliniği; [5]Henriettenstiftung Hospital, Hannover; [6]Akdeniz University Department of Orthopedics and Traumatology

Amaç: Motor beceri eğitimi içerisinde yer alan yöntemlerden biri, hedef işlemi oluşturan bireysel becerileri öğrenciye ayrı ayrı öğretmektir. Bu eğitim yöntemi hedef işlemin parçalarının tanımlanmasını gerektirir. Bu çalışmada, artroskopik girişimi oluşturan temel motor becerilerin tanımlanması amaçlandı.

Çalışma planı: Çalışmaya toplam 42 ortopedist (ort. yaş 38±8) katıldı. Çalışma grubuna, en az 10 yıldır uzman olarak çalışmakta olan ve yıllık artroskopi sayıları 50'nin üzerinde olan 17 deneyimli ortopedist; kontrol grubuna ise deneyimi üç yıldan daha az olan 25 genç ortopedist ve asistan alındı. Tüm katılımcılar aynı zamanda ve aynı eğitim ortamında değerlendirildi. Laboratuvar ortamında, temel motor becerileri simüle eden aletler her katılımcıya tek tek tanıtıldı ve her katılımcının asıl değerlendirme öncesinde bir kez deneme yaparak işlemi tanıması sağlandı.

Sonuçlar: Deneyimli grupta, kontrol grubuna göre ortalama yaş (42 ve 34.4), artroskopi deneyimi süresi (12.4 ve 1.6 yıl) ve yıllık ortalama artroskopi sayısı (93.9 ve 26.9) anlamlı derecede fazla bulundu (p=0.000). Deneyimli grupta, ortalama önceleme zamanı (p=0.028) ve iki kol koordinasyon zamanı (p=0.043) anlamlı derecede kısaydı. Korelasyon analizinde, artroskopi deneyim süresi ile ortalama önceleme zamanı (r=-0.41, p=0.008) ve iki kol koordinasyon zamanı (r=-0.33, p=0.033) arasında anlamlı ilişki saptandı. Yapılan artroskopi sayısı arttıkça ortalama önceleme zamanı anlamlı olarak kısalmaktaydı (r=-0.446, p=0.003).

Çıkarımlar: Bazı temel motor beceriler artroskopik beceriklilik ile ilişkilidir. Motor becerileri geliştiren bu araçların artroskopi eğitiminde kullanılmasının artroskopik beceri geliştirilmesini kolaylaştıracağı söylenebilir.

Anahtar sözcükler: Artroskopi/eğitim; klinik ustalık; kinestezi; motor beceri; psikomotor performans; görev performans ve analizi; zaman algılaması.

Objectives: One of the methods in motor skill teaching is to furnish the students with the individual skills drawn from the target procedure. This method requires identification and defining of all components of the target procedure. This study aimed to define basic motor skills composing arthroscopic skillfulness.

Methods: A total of 42 orthopedists (mean age 38±8 years) were enrolled. The study group was comprised of 17 experienced orthopedists working at least for 10 years as a specialist and performing more than 50 arthroscopic procedures per year. The control group included 25 young orthopedists or residents having an arthroscopic experience of less than three years. All the participants were assessed simultaneously and in the same experimental setting. Each participant was tested after having been shown to use *in vitro* skill development instruments simulating arthroscopic basic motor skills.

Results: Compared to the control group, the experienced group had significantly higher mean age (42 *vs*. 34.4 years), longer duration of arthroscopic experience (12.4 *vs*. 1.6 years), and greater number of the arthroscopies performed per year (93.9 *vs*. 26.9) (p=0.000). The mean anticipation time (p=0.028) and two-arm coordination time (p=0.043) were significantly shorter in the experienced group. In correlation analysis, duration of arthroscopic experience was correlated with the mean anticipation time (r=-0.41, p=0.008) and two-arm coordination time (r=-0.33, p=0.033). In addition, the mean anticipation time decreased significantly as the number of arthroscopies increased (r=-0.446, p=0.003).

Conclusion: Some basic motor skills correlate with arthroscopic competence. The use of these motor skill instruments in arthroscopy training may aid to improve arthroscopic skills.

Key words: Arthroscopy/education; clinical competence; kinesthesis; motor skills; psychomotor performance; task performance and analysis; time perception.

Correspondence / Yazışma adresi: Dr. Mustafa Karahan. Marmara University School of Medicine, Department of Orthopedics and Traumatology, 34662 Altunizade, İstanbul. Phone: 0216 - 363 46 56 e-mail: mustafa@karahan.dr.tr

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Arthroscopic procedures are one of the leading procedures and have shown enormous growth over the years according to one study.[1] Importance of training for arthroscopic surgery is well recognized and exclusive training programs are present in teaching hospitals throughout the world. Less teaching time in the clinical setting imposed by major changes in the medical practice has forced the teaching surgeons to search for newer methods of teaching. Search for effective teaching methods has extended to non-surgical disciplines such as kinesiology and included the science of learning.[2]

Surgical technical skills are considered a subset of motor skills.[3] Basic motor skill acquisition concept which is present in every activity requiring motor action could be applied to teaching surgical skills as well.[4,5] Skill identification and complex task training has been proved to be of value in motor skill teaching.[6,7]

Beginners do not learn basketball while a game is going on. They are allowed to play a full court only after they have learned how to dribble, pass and shoot among other skills. Similarly, systematic training of repetitive combinations of basic movements such as continuous and punctuated, circular and linear movements has facilitated young music students to acquire basic motor skills essential for conducting.[4]

Existence of basic components of a whole surgical procedure was shown in a study.[5]

In this study, learning of the basic component has enabled the surgeon to perform better in a different surgical procedure containing some of the basic components of the initial procedure. The study has shown that the basic components are learned distinctively and may be transferred.

The aim of this study is to try to define basic motor skills that make up the whole of the arthroscopic procedures. Through a crude eye's observation during an arthroscopic procedure 2 upper limbs are simultaneously used, hand and eye coordination is performed, prompt and judicious reaction is executed.

We hypothesized that higher scores on instruments simulating basic motor skills obtained by the experienced surgeons will show the basic motor skills that are developed throughout the years. If identified, the basic motor skills could then be used for the training of the beginners.

Materials and methods

Forty-two physicians 42 ± (25- 60 yrs) were included in the study. There were 17 experienced orthopedic surgeons in the study group who were an expert in orthopedics for more than 10 years and whose yearly number of performed arthroscopies were more than 50. The control group consisted of 25 surgeons in training and junior orthopedic surgeons whose expertise was less than 3 years in the discipline. Subjects were tested at the 15th Basic Arthroscopic Course organized by the Antalya Branch of Turkish Society of Sports Traumatology, Arthroscopy and Knee Surgery Society and results were evaluated at Dr. Veli Lök Motor Skill Development Laboratory at Marmara University Sports Sciences and Sports Health Research and Application Center. All physicians were tested at a training course site where the experienced surgeons (study group) and non-experienced surgeons (control group) were at the same site. Tests were individually introduced to each surgeon and allowed to try a single time prior to index test.

Basic motor skills that constitute arthroscopy as a final task is listed in table 1 and the names of the instruments that simulates a basic figure is shown in fig 1. The names of the instruments were; standard rotary pursuit, visual choice reaction, two-arm coordination test, hydraulic hand dynamometer and basin anticipation timer. (Lafayette Instrument Company, Lafayette, Indiana).

Statistical analysis

Descriptive statistics are presented as arithmetic means ± standard deviations (SD) and medians. To test the hypothesis we used a study and a control group, determining the duration that they had begun to perform arthroscopy and the number of the arthroscopic

Table 1. Basic motor skills presented in the task analysis of arthroscopy

Triangulation	Procedures peformed by using two hands
Depth perception	Ability to differentiate the position of objects in two dimensional images
Response orientation	Ability to rapidly select a response from a number of alternatives, as in choice reaction time (RT) situations
Reaction time	Ability to rapidly initiate a response to a stimulus
Grip strength	Strength of hand muscles

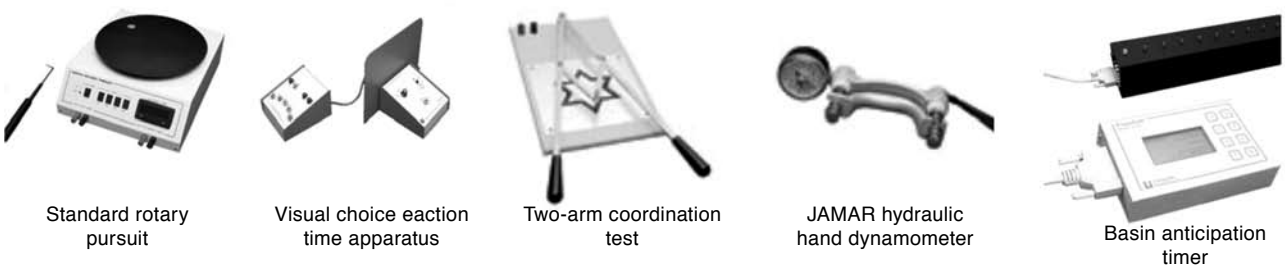

Figure 1. Instruments used to assess the basic motor skills of the surgeons (included with permission from Lafayette Instrument Company, Lafayette, Indiana)

procedures they performed in a year. The statistical significance of a difference in mean fold of each group was evaluated by using student t-test or non-parametric Mann-Whitney U test when means of categorical variables were analysed. Correlations between the various motor skill measurements and the frequency of the performed arthroscopic surgeries were tested for significance by Spearman rank correlation test. A result was considered to be significant if p was less than 0.05. All statistical analysis was performed using SPSS version 11.5.

Results

The general characteristics of the participants and of both the study and control groups are summarized in Table 2. Average number of the arthroscopies in a year was 55.3. Three of the participants had no arthroscopy experience. The experience period of the participants ranged from 0 to 26 years (mean ± SD; 6.0 ± 6.8). Mean number of the yearly performed arthroscopies (more than 50 in a year) and the duration that they had begun to perform arthroscopy was significantly higher that the control group. Arthroscopic experience period in the control group was 0 to 3 years only.

There was a significant difference in mean anticipation time scores and double arm coordination time between the study and the control groups (p=0.028, p=0.043) Mean anticipation time was getting shorter in the experienced (study) group. There was a significant correlation between the experience years of the surgeons' and mean anticipation time and bilateral arms coordination time scores were respectively r= -0.41; p=0.008 r= -0.33; p=0.033. As the surgeons were getting more experienced, mean anticipation and coordination times were getting shorter (Table 3). The mean anticipation time decreased significantly as the number of arthroscopies increased (r=-0.446, p=0.003)

The measurements (tests that we used to assess the basic motor skills) show significant correlations among each other that correlation coefficients show the reliability of the measurements. Mean anticipation time scores correlated with anticipation time at a speed of 40 mph scores (r=0.53; p=.000) and mean reaction time (r=0.40; p=0.009), hand grip scores correlated with "two arm coordination" (r= -0.32; p=0.042), rotary pursuit off scores correlated with mean anticipation time scores (r=0.34; p =0.026) and rotary pursuit on (r=-0.70: p=.000).

Discussion

Skill refers to expert performance at a particular task with maximum certainty and minimal use of energy or time.[3] Skills are commonly categorized as cognitive or motor. Cognitive skills are those invol-

Table 2. Characteristics of the participants (N=42) and the differences between the study and the control groups

	Minimum-Maximum (N=42)	Mean± SD	Study Group (Experienced)	Control Group (Inexperienced)	*p* (T-Test)
Age (year)	25.0 - 60.0	37.5±8.2	42.0±8.5	34.4±6.5	**0.000**
Number of yearly performed arthroscopies (n)	0.0 - 225.0	55.3±59.5*	93.9±60.2	26.9±41.3**	**0.000**
Number of years performing arthroscopy (year)	0.0 - 26.0	6.0±6.8	12.4±6.5	1.6±1.1	**0.000**
Anticipation time (sec)	47.7 - 200.7	104.3±35.7	90.7±33.0	113.6±35.2	**0.028**
Bilateral arm coordination time (sec)	17.0 - 62.0	35.3±11.9	31.7±12.1	37.7±11.3	**0.043**

*Median 35.9; **Median: 10.0.

Table 3. Results of Spearman Correlations between the items

	Age		Number of years performed (year)		Number of performed arthroscopy		Average no of arthroscopy per year	
	r	*p*	r	*p*	r	*p*	r	*p*
Mean reaction time	0.243	0.121	0.093	0.559	-0.032	0.842	-0.131	0.409
Anticipation time at a speed of 40mph	-0.104	0.511	-0.265	0.090	-0.366	**0.017**	-0.343	**0.026**
Mean anticipation time	-0.147	0.353	-0.405	**0.008**	-0.446	**0.003**	-0.264	0.091
Hand grip total	-0.312	**0.045**	-0.091	0.567	-0.056	0.726	-0.006	0.971
Mirror error time	0.058	0.715	-0.034	0.832	-0.102	0.521	-0.077	0.630
Double arm coordination time	-0.057	0.720	-0.330	**0.033**	-0.192	0.223	0.006	0.970
Rotary pursuit on	-0.105	0.507	0.081	0.610	0.056	0.723	-0.137	0.386
Rotary pursuit off	0.244	0.119	-0.041	0.798	-0.048	0.762	0.225	0.152

*Spearman's rho,

**p<0.05

ving proficiency with mental functions, such as decision making and problem solving. Motor skills are concerned with proficiency in physical performance and co-ordination of physical actions. Surgical technical skills are considered a subset of motor skills.[6] The experienced surgeon's performance, like that of any expert in an area requiring sophisticated motor skills, appears simple, graceful, smooth, and incredibly efficient; the novice's performance in the same surgical situation may be clumsy, ineeffective, and highly inefficient.[2]

What differentiates an experienced arthroscopic surgeon and a non-experienced surgeon in terms of motor skills is unclear. We tried to look into what experience promotes in the surgeon in terms of motor skills when arthroscopic surgical procedures are involved. This study is the first of its kind in the English and Turkisn literature in dissecting arthroscopic procedures into basic motor skills. In a previous study done by Neequaye et al, a group of surgeons in residency has been assigned to two surgical procedure groups which they were asked to switch upon completion. It was shown that the surgeons did better in their secondary performances which showed that they were able to transfer some of the skills that existed in both procedures. The results of the study provoke us to think that exercising basic skills may help in achieving excellence in the "ultimate surgical procedure".

We were unable to refer to a study when trying to determine the basic motor skills regarding arthroscopic performance. An objective observation will disclose that when arthroscopic procedures are performed 2 upper limbs are simultaneously used, hand and eye coordination is performed prompt and judicious reaction is executed. We therefore used instruments that will measure us the above mentioned basic skills which are standard rotary pursuit, visual choice reaction, two-arm coordination test, hydraulic hand dynamometer and basin anticipation timer (figure 1).

Both the correlation tests and mean comparing tests show that with advancing year of experience and number of arthroscopic surgeries performed, bilateral arm coordination time significantly decreases favorably. This result may be interpreted in a general observation as "experienced surgeons can use both of their arms simultaneously in harmony".

Our results reveal that experienced surgeons react faster and more judiciously compared to inexperienced. The experienced surgeons anticipated the time to act and acted significantly better than the non-experienced surgeons. Anticipation was shown to be a factor of importance when experience is concerned in a previous study.[2] Experienced surgeons drilled a bone with less penetration into the soft tissue than non-experienced .Our study has confirmed that experienced surgeons have better anticipation skills.

Evidence suggests that a well structured curriculum for surgical skills improves performance [4] contributing to the belief that motor skill training

is necessary and will create a difference in skill learning. However the relation between basic motor skills and related procedural experience emphasizes that if two mentioned basic motor skills are addressed early on in training, it may positively influence surgical performance later on in practice. That kind of training will let the teacher to promote arthroscopic skills in a shorter and safer way. The development of basic motor skills and visual-spatial skills will be more efficient and trainees will become reasonably automatic before proceeding with the surgical arthroscopy with real patients.[8, 9]

We are unable to conclude whether the application of a new teaching concept (skill identification) will make a difference in performance of the trainees or not. We are also unable to compare if it is more effective than the traditional surgical training based on master-apprentice model since Hippocrates. However, the study shows that there are differences regarding basic motor skills between the groups which traditionally have similar backgrounds where only age and experience are the differing factors. A further case control or randomized controlled educational trial study such as "measuring performance before and after the skills training" will be able to validate this assumption and to evaluate the effects of basic motor training in the last product which is gaining of arthroscopic skill.

In conclusion, surgeons who are more experienced seem to be more skillful in certain basic motor skills. Experienced surgeons can use both of their arms simultaneously in harmony. Experienced surgeons react faster and more judiciously. These motor skills may be considered as teaching tools to be used in arthroscopic surgery teaching for the beginners.

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