

## The Effect of Using Static and Dynamic Stretching Techniques on Flexibility in Artistic Swimming

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### Abstract:

Artistic swimming a complex and physically demanding sports, in which the strength and the velocity of movements are combined with high flexibility requirements. Flexibility is one of the main physical abilities required in Artistic swimming. This sport requires athletes to have a high level of physical training, mastery of complex technical skills, and artistry. The level of athlete's flexibility is an important prognostic indicator of performance. **The aim of study:** to determine the effect of static and dynamic stretching on improving the flexibility in artistic swimming. **Methodology:** 7 female subject's aged 11 years, height 135.00 cm, Weight 33.00 Kg were selected to participate in this study were assigned to one experimental group, participated in 6 weeks as static and dynamic stretching exercises. The program targeting on specific muscle groups around the hip joint to increase flexibility and contributing better performance in the water including Hip Flexors, Hamstrings, Gluteus, Inner Thighs and Hip Rotators. **Results:** The results of this study indicate significant improvements in flexibility across various measures following a targeted program. The findings align with existing researches on flexibility training, which suggests that structured stretching routines can enhance joint range of motion and overall flexibility.

**Keywords:** Dynamic stretching, static stretching, flexibility, Artistic Swimming.

### تأثير استخدام تقنيات الإطالة الثابتة والديناميكية على مرونة في السباحة الفنية

تعتبر السباحة الفنية من الرياضات الفريدة من نوعها ، حيث تتطلب مستوى عال من القدرات البدنية من حيث القوة، التحمل، التوافق، التوازن والمرونة. المرونة هي واحدة من القدرات البدنية الرئيسية المطلوبة في السباحة الفنية، وذلك لطبيعة الأداء الفني بتلك الرياضة الذي يتطلب تحقيق الكمال التقني للمهارات الفنية في إطار منسق وجميل.

يهدف البحث الى التعرف علي تأثير استخدام تقنيات الاطالة الثابتة والديناميكية علي المرونة في السباحة الفنية.

استخدمت الباحثة المنهج التجريبي نظراً لملائمة لطبيعة البحث وذلك لمجموعة تجريبية واحدة بإتباع القياسات القبلية والبعدي لعينة البحث. أشتملت عينة البحث على لاعبات السباحة الفنية والبالغ قوامهم (7) لاعبات، واللاتي يتراوح أعمارهن 11 سنوات، تراوحت مدة البرنامج الي ستة أسابيع. وكانت اهم النتائج وجود فروق ذات دلالة احصائية بين القياسين القبلي والبعدي لاختبارات مستوي الاداء البدني والمهاري للاعبات في السباحة الفنية لمرحلة 11 سنوات لصالح القياس البعدي حيث جاءت قيمة "ت" المحسوبة أعلى من قيمة "ت" الجدولية.

مصطلحات البحث: الاطالة الثابتة، الاطالة الديناميكية ، المرونة ، السباحة الفنية.

## The Effect of Using Static and Dynamic Stretching Techniques on Flexibility in Artistic Swimming

### Introduction

Artistic swimming is a dynamic and aesthetic sport characterized by repeated periods of underwater, it demanding a high level of flexibility, kinesthetic awareness, aerobic and anaerobic conditioning (Ermakhanova & Nurmuhabetova, 2018). As a sport that blends Artistic swimming with gymnastics and dance movements in water following musical rhythm that involve a wide range of motion and body contortions (Ponciano, K. et al., 2018).

Artistic swimming Competitions are performed as solos, duets and teams, in which the athletes perform artistic routines of elaborate movements (Mia peric 2012). During routines, artistic swimmers are judged based on accuracy, control, height, stability, and extension. Accordingly, this sport requires a higher level of coordination and combines the skills of motor qualities such as strength, endurance, and especially flexibility (Herodek, K. et al., 2005).

In artistic swimming Flexibility is crucial, as it enhances the ability to execute precise, elegant movements, and maintain proper body alignment to create a more polished and aesthetically pleasing appearance. This enhances the visual impact of the routine, making it look more graceful and elegant. It also places a high value on visual presentation and artistic impression score (FINA, 2022)

It also involves precise synchronized movements and high-risk of acrobatic elements during routines, therefore it's important to improve the range of motion and the extension for the swimmers. without sufficient flexibility, the swimmers would struggle to achieve full extension in their movements.

Flexibility is a prerequisite that contributes to the increase of magnificence from the point of view of technical appreciation, being responsible for the accuracy and precision in artistic swimming (Cho, N.M.Y. et al., 2017). It also allows swimmers to create more visually appealing elements, which are crucial for technical execution which can elevate their routines to a higher level of difficulty. Both flexibility and range of motion is interrelated. Therefore, the muscle and other connective tissues around the joint should be stretched. When we stretch the connective tissues surrounding the joints will increase the range of motion, thus we can improve the aesthetic quality and execution of the routine (D. Scott, et al., 2005).

To preserve the range of motion in joints and soft tissues, as well as to improve the muscle flexibility, it's essential to integrate various stretching to improve flexibility, with various techniques recommended for athletes. Among these, static and dynamic stretching are two prominent approaches. Static stretching is the stretching of a muscle or muscle group to reach the maximum points and then maintain and hold them in that position (D. Scott, et al., 2005) until tension occurs and achieves, then maintain this position for 20 to 30 seconds so as to increase joint extension (Walker, 2011). It is also a type of exercise that takes place in a static state without any additional movement other than the movement of stretching muscles.

Dynamic stretching involves moving the body or limbs in a rhythmic manner without maintaining the farthest stretching position. This type of stretching helps the nervous system to progressively increase the space, which can enhance joint mobility and lower the risk of injury. Additionally, it raises muscle temperature and prepares muscles for physical activity (Suharjana, F. 2013).

(Nora M. Y. et al., 2017) found that high levels of proprioceptive & flexibility awareness were linked to improved performance in the water, while specific flexibility measurements were essential for achieving the required positions in artistic swimming. The findings emphasize the importance of targeted training programs that enhance both proprioception and flexibility to optimize athletic performance in this demanding sport.

(Chirino Matos et al., 2022) informed the importance of a structured flexibility training program tailored for young artistic swimmers. By incorporating diverse stretching techniques and progressively challenging exercises, coaches can effectively develop flexibility, which is essential for optimal performance in the sport. In addition, ( Adela et al., 2022) also reported that flexibility training program is highly effective for young artistic swimmers. The improvements in segmental flexibility not only enhanced their athletic performance but also contributed to better overall physical development.

Through research observations and follow-up as a national judge in the Egyptian Swimming Federation, Swimmers need to exhibit high flexibility and hip range of motion in their splits because it has become evident that swimmers have lack hip flexibility during artistic swimming competitions. Being flat on land is not sufficient, splits must be flat in the water with excellent extension which requires an extreme range of motion and the functional strength to maintain the position while upside down. Therefore, it is crucial to develop over-splits to achieve flat splits in the water.

### **The aim of the study**

This study aimed to assess the effects of using static and dynamic stretching techniques on flexibility in artistic swimming.

### **Materials and Methods**

#### **Research Methodology**

The researcher used the experimental method by using the experimental design of one group and by making the two measurements (pre-post).

#### **Subjects**

Seven artistic swimmers, age 11 to 12 years old, volunteered from Zamalek sporting club to participate in the present study. All the participants were free of injury, they took part in competitions 3 - 4 times per year according to the Egyptian Federation calendar. In Table 1. we present the subject's characteristics measurements of our sample.

**Table 1.** Descriptive statistics for subject's characteristics in Age, Height and Weight  
(N= 7)

Variables	Minimum	Maximum	Mean	Std. Deviation	Skewness
Age (years)	11.80	12.50	12.20	0.28	-.309
Height (cm)	135.00	160.00	147.14	11.01	.266
Weight (kg)	33.00	50.00	41.07	7.40	.206

**Table 1.** shows the Descriptive statistics for subject's characteristics in Age, Height and Weight.

### Procedures

One week before starting the program, all characteristics measurements were made. Furthermore, some physical and technical performance tests were measured in specific movements using the hip joint for all athletes. Each movement reflects to the maximum range of motion.

### Measures

#### Right /Left leg split

The swimmers stand with feet shoulder-width apart, facing forward. They perform a split by extending one leg forward and the other leg backward, keeping both legs as straight as possible. The angle formed by the extended legs is measured to determine the degree of flexibility (Hold 10 sec).

#### Side split

The swimmers sit on the floor with their legs extended in a straddle position. Hip bones facing forward (square hips), shoulders over hips and the arms extended behind body. legs and feet extended on horizontal line, knees facing upwards and the body upright. When the swimmers reach the lowest possible position, the examiner measures the height from the axis of the pubis to the ground (Hold 10 sec).

## Standing split with hands on ground – Needle Position (Draw)

The swimmers begin in a standing position with feet together and arms by their sides. They lift one leg as high as possible while keeping it straight and parallel to the ground. At the same time, the swimmer's drawn leg is extended upwards with foot pointed in a standing split position (Needle). It is allowed to extend past 180 degrees, minimum of 190 degrees (Hold 10 sec.). The angles of the leg for the swimmers were measured by using Ipinpoint application.

## Technical performance tests

Two days before starting the program, several tests were applied to assess technical performance Right, Left split & Ariana Rotation. Swimmers' assessment by three artistic swimming judges.

## Stretching Protocol

A stretching protocol for the swimmers typically includes a combination of dynamic and static stretches to developing flexibility with an emphasis on improving the mobility and hip range of motion. The programme targeting on specific muscle groups around the hip joint to increase flexibility and contributing better performance in the water including Hip Flexors, Hamstrings, Gluteus, Inner Thighs and Hip Rotators (Figure 1).

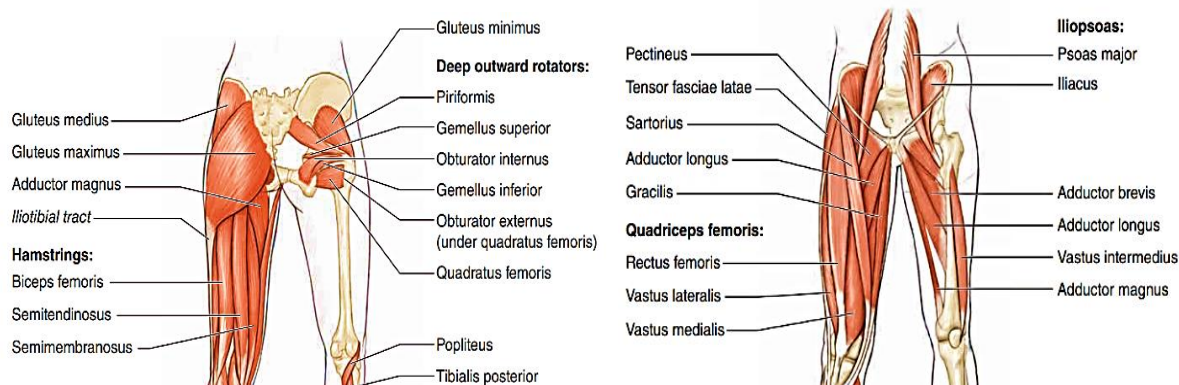


Figure 1. Stretching Muscle Groups

## Stretching program

One week before starting the stretching program, the researcher demonstrated and explained correctly to all swimmers the right techniques for all exercises before started the training period.

One experimental group trained on the training program for six weeks, 4 times per week. The program consisted of land & aquatic exercises. All training sessions were preceded by a 10 -15 minutes warm-up, and approximately 20 - 45 minutes for the essential part of the training, and 10 minutes cooling down.

The exercises were performed with each set lasting 30-s with 15-s rest periods between sets. The training program focused on segmental exercises in rhythmic gymnastics, adapted to the specific techniques of artistic swimming. The exercises were gradually increased every week during the weeks of the program.

The program, start with dynamic stretching to warm up the muscles and prepare them for activity by increasing blood flow and flexibility. It involves moving the muscles and joints through a full range of motion in a controlled manner. After the dynamic stretching phase, static stretching can be performed. It involves holding a stretch position for a period of time to elongate the muscles and improve flexibility.

**Table 2.** Training program exercise divided into three stages

Stages	Weeks	Type of Stretching
One	Week 1 & 2	Dynamic stretching
Two	Week 3 & 4	Dynamic & Static stretching
Three	Week 5 & 6	Dynamic & Static stretching

## Statistical Analysis

Statistical analyses were performed using the SPSS version 20 in addition the improvement ratios were analyzed. Paired samples T test was

used for evaluating and comparing the variables between pre and post-tests, level of significant  $P < 0.05$ .

## Results

**Table 3.** Descriptive statistics for Physical and skill performance level

(N= 7)

Variables	Measuring Unit	Minimum	Maximum	Mean	Std. Deviation	Skewness
Right leg split	cm	3.00	18.00	8.57	4.89	1.211
Left leg split	cm	5.00	20.00	12.29	5.53	-.372
Side split	cm	10.00	30.00	18.43	7.48	.537
Stand split Right	Degree	108.97	162.24	131.60	19.30	.664
Stand split Left	Degree	100.02	150.66	121.66	17.81	.698
Right leg split	Degree	4.50	7.50	6.07	1.13	.235
Left leg split	Degree	4.50	7.50	5.64	1.07	.772
Ariana Rotation	Degree	4.75	7.25	5.86	0.93	.362

**Table 3.** shows the Descriptive statistics for physical and skill performance level.

**Table 4.** Mean ( $\pm$ SD), T, P value and Progress Percentage for the Research Physical Measurements

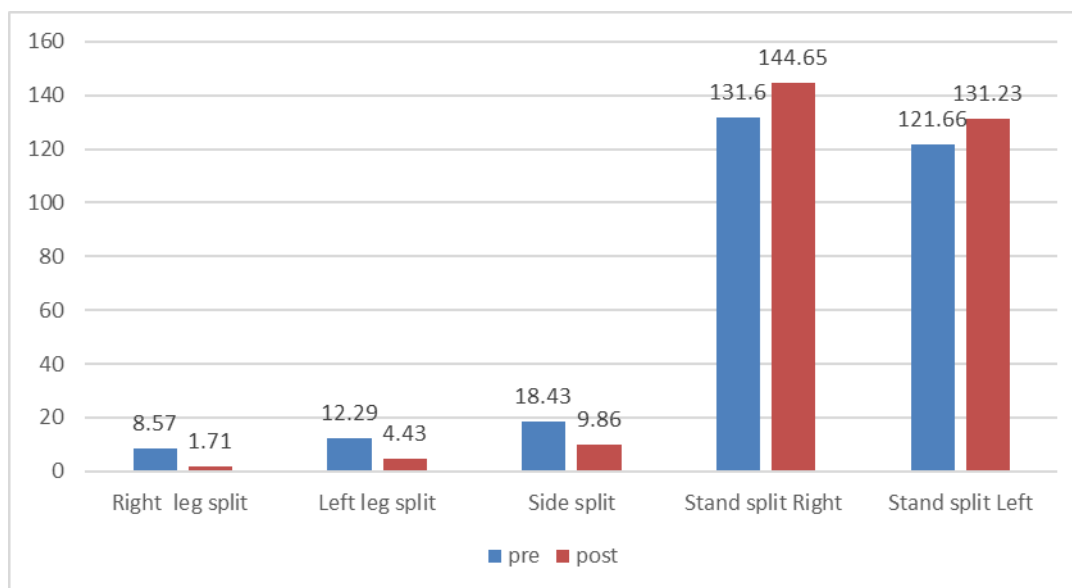
(N=7)

Variables	Measuring Unit	Pre-measurements		Post-measurements		T	P value	Progress %
		$\bar{X}$	SD	$\bar{X}$	SD			
Right leg split	cm	8.57	4.89	1.71	1.89	5.793	.001	80.05 %
Left leg split	cm	12.29	5.53	4.43	3.51	7.966	.000	63.95 %
Side split	cm	18.43	7.48	9.86	5.76	11.921	.000	46.50 %



Stand split Right	Degree	131.60	19.30	144.65	18.69	- 17.867	.000	9.92 %
Stand split Left	Degree	121.66	17.81	131.23	16.22	- 10.136	.000	7.87 %

**Table 4.** shows that there is a significant difference between the Pre and Post for the physical measurements for the Research Experimental group with a progress percentage from (7.87-80.05%).



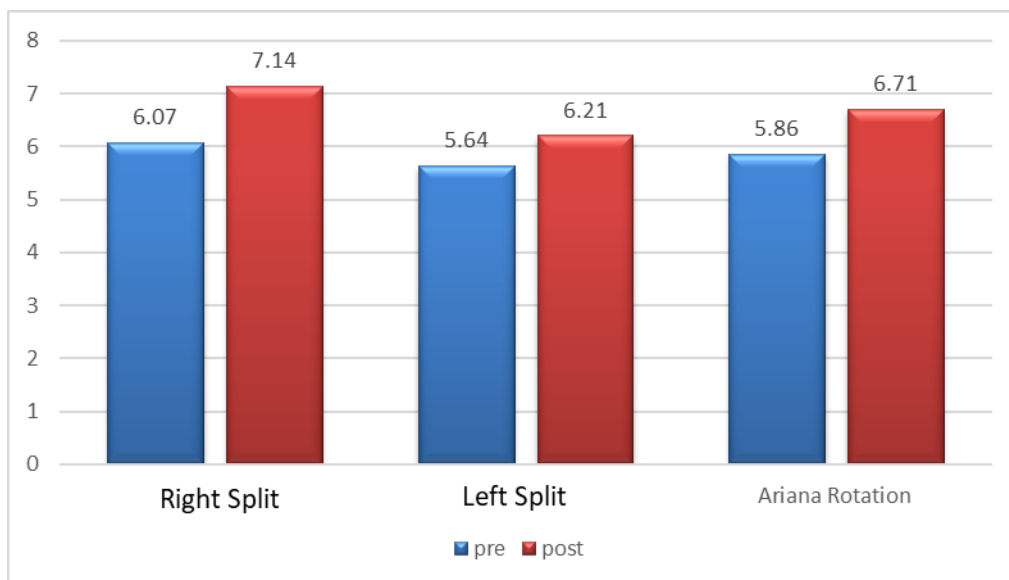
**Figure 2.** Average Pre- and Post- Measurements for the Research Physical Characteristics Tests

**Table 5.** Mean ( $\pm$ SD), T, P value and Progress Percentage for the Technical performance Tests

(N=7)

Variables	Measuring Unit	Pre-measurements		Post-measurements		T	P value	Progress %
		$\bar{X}$	SD	$\bar{X}$	SD			
Right leg split	Degree	6.07	1.13	7.14	1.18	- 15.000	.000	17.63 %
Left leg split	Degree	5.64	1.07	6.21	0.95	-2.828	.030	10.11 %
Ariana Rotation	Degree	5.86	0.93	6.71	0.91	- 16.971	.000	14.51 %

**Table 4.** shows that there is a significant difference between the Pre and Post for Technical performance measurements for the Research Experimental group with a progress percentage from (10.11- 17.63%).



**Figure 3. Average Pre- and Post- Measurements for the technical performance Tests**

## Discussions

The present study aimed to assess the effect of static and dynamic stretching techniques on flexibility among artistic swimmers. The results of this study indicate significant improvements in flexibility across various measures following a targeted program. The findings align with existing researches on flexibility training, which suggests that structured stretching routines can enhance joint range of motion and overall flexibility.

**Data showed as presented in table 4** substantial improvement in both the right and left leg splits (80.05% and 63.95% respectively), side split (46.50%), this is consistent with findings from several studies. A systematic review (Behm and Chaouachi 2011) highlighted that regular stretching can lead to significant gains in flexibility, particularly when performed consistently over time. The gains observed in our study echo their findings that targeted flexibility training can yield considerable improvements in lower limb flexibility.

And enhancements in the standing splits (9.92% for right and 7.87% for left) indicate that even slight improvements can be significant. Furthermore, the differences noted in the standing splits could be reflective of individual flexibility differences, as highlighted by a study from (Hales et al. 2018), they found that many individuals exhibit unilateral flexibility differences, which can be addressed through targeted interventions to ensure balanced development. Also (O'Sullivan et al. 2009) suggests that increasing flexibility in standing positions can be crucial for athletic performance and injury prevention. Their findings emphasize the importance of incorporating standing stretches in a flexibility routine to enhance stability and control, which may explain the significant changes in our results.

**Data showed in table 5** improvement in the right leg split from a pre-measurement average of  $6.07^{\circ}$  to a post-measurement average of  $7.14^{\circ}$  (17.63% increase). This enhancement suggests that both static and dynamic stretching techniques effectively increased the range of motion in technical performance. The significant T-value of -15.000 and a p-value of .000 indicate robust statistical significance.

The left leg split showed a pre-measurement average of  $5.64^{\circ}$  and a post-measurement average of  $6.21^{\circ}$ , resulting in a 10.11% increase. While this progress is slightly less pronounced than the right leg split, the T-value of -2.828 and p-value of .030 still indicate statistical significance. This bilateral difference might reflect individual variations in flexibility or differences in training emphasis.

The improvements in leg splits are particularly relevant for artistic swimming, where athletes must often display extreme flexibility during performances. A study by (O'Sullivan et al. 2009) found that athletes with greater flexibility tend to perform better in sports requiring extensive range of motion. As the right leg split improved by 17.63% and the left leg split by 10.11%, this increased flexibility can lead to enhanced performance in routines, as athletes can execute elements with greater precision and aesthetics.

The Ariana rotation demonstrated a pre-measurement average of  $5.86^{\circ}$  and improved to  $6.71^{\circ}$ , yielding a 14.51% increase. The T-value of -

16.971 and p-value of .000 indicate strong statistical significance, suggesting that the intervention effectively enhanced rotational flexibility.

In artistic swimming, the ability to rotate effectively while maintaining form is crucial for elements. Improved rotational flexibility enables athletes to perform these movements more fluidly, enhancing overall routine quality. Previous studies support these results, indicating that improved flexibility in rotation can significantly affect performance in sports requiring agility and dynamic movements (Behm & Chaouachi, 2011).

### **Conclusion:**

Research suggests that both static and dynamic stretching techniques can have positive effects on flexibility in artistic swimming. Static stretching involves holding a position for a prolonged period, while dynamic stretching involves moving a joint through its full range of motion.

Static stretching has been traditionally used to improve flexibility, and it can be effective in increasing the length of the muscle and its surrounding connective tissue. This can lead to improved range of motion and flexibility over time. However, some studies have shown that excessive static stretching immediately before a performance may temporarily decrease muscle strength and power, which could be detrimental in activities that require explosive movements, such as artistic swimming routines.

On the other hand, dynamic stretching has been found to be effective in improving flexibility while also helping to maintain or even enhance muscle power and performance. Dynamic stretching can increase blood flow to the muscles, improve neuromuscular function, and prepare the body for the specific movements involved in artistic swimming. Therefore, a combination of both static and dynamic stretching techniques may be beneficial for artistic swimmers.

### **Recommendations:**

1. Develop individualized flexibility training regimens focusing on enhancing both static and dynamic flexibility for each leg.

2. Prioritize dynamic stretching techniques in warm-ups to improve flexibility and range of motion.
3. Implement regular assessments of flexibility metrics to monitor progress and adjust training protocols accordingly

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