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Professional paper

IMPORTANCE OF DEVELOPING STRENGTH ENDURANCE IN ARCHERS [1]

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Abstract: Success in archery depends on numerous factors, one of the fundamental ones being an archer's ability to achieve a high level of focus and consistency over an extended period during competitions. This is primarily achieved through one of the four defined aspects of archery — physical fitness, specifically well-designed and tailored strength endurance exercises. The first goal of this analysis is to highlight the extent of exertion, the significance, and the essential need for strength endurance in archers. The second goal is to present a methodology for achieving the necessary level of physical fitness, particularly strength endurance in archers. It is anticipated that by assessing an archer's initial physical fitness level and then applying exercises designed to develop the required strength endurance, including "SPT" (Specific Physical Training) for endurance, strength/force, flexibility, and structure, as well as "modality" exercises, an archer's abilities will be enhanced. This analysis, based on a review of literature and expert opinions, incorporates experience from working with archers, as well as insights from foreign coaches obtained through lectures, seminars, published papers, or books. Based on the exercises and methodology used in this paper, it is assumed that they will contribute to improving an archer's abilities in the training process, ultimately leading to better performance results.

Keywords: *strength endurance, SPT, archery, physical fitness*

INTRODUCTION

The earliest known archaeological evidence of archery in the history of Homo sapiens (arrowheads found in the Sibudu Cave, present-day South Africa) dates back to the Stone Age (approximately 64,000 years ago, marking the transition from the Upper Paleolithic to the Mesolithic period) ("Strijela", 2024). The first known composite recurve bow, the Assyrian bow (currently housed in the Archery Museum in France), dates back to around 3000 BCE (Kavak, 2022).

Throughout history, from ancient Egypt, Japan, and China, through the Greco-Roman period and Mongolia, to the famous Battle of Agincourt, the bow and arrow played a significant role in warfare. With the introduction of

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firearms and the ability for rapid successive shooting, archery gradually transitioned into a sport. In 1900, archery made its first appearance at the Olympic Games (Ergen & Hibner, 2004).

In our region, in Serbia, an archery range near Novo Brdo was mentioned in 1413, where archery practice took place and where Dubrovnik residents came for training and recreation (Streličarski savez Srbije, 2021). The first modern archery clubs were founded in Novi Sad in 1964 and in Belgrade, where SC Kalemegdan was established in 1977 (Salopek, 1984).

Historical records and discovered artifacts indicate the remarkable power of medieval bows. For example, artifacts recovered from the sunken ship *Mary Rose*, the vessel of Henry VIII, which was found in Portsmouth Harbor in 1545, included 3,500 arrows and 137 intact bows. According to estimates by Robert Hardy, these bows had a draw weight of 150–160 lbs (670–710 N) at a 30-inch draw length. Additionally, details about the power of English longbows used in the Battle of Agincourt suggest that their draw weight ranged from 140 to 155 lbs ("English longbow", 2024; "Archery", 2024).

These historical accounts indicate that archers have always needed significant strength endurance, regardless of technology, skill, or shooting technique, to accurately shoot such powerful bows. Kooi & Sparenberg (1997) and Cornwell (2009) state that archers were capable of accurately shooting twelve arrows per minute with bows of exceptional draw weight, ranging from 140 to 160 lbs.

Despite the historical context, even today, although bows are less powerful and technologically far superior, the fundamental need for strength endurance in archers remains. To accurately shoot 300–500 arrows per day with a 45–50 lbs bow at a distance of 70 meters—requiring about 5–7 hours of training per day, six days a week, year-round—clearly demonstrates the essential need for a systematic development of strength endurance in modern archers, regardless of age, gender, category, or shooting style.

The necessity of developing physical fitness enables modern archers to build a stronger physical foundation, a more robust core, reduced symptoms of circadian rhythm disruption (*jet lag* due to frequent intercontinental travel), faster recovery, greater resilience to stress, the ability to complete the same training volume with less effort, and a reduction in the asymmetrical effects of the sport (Kaminski, 2017). Developing strength endurance in archers enhances their stamina, power, flexibility, and proper use of muscle structure (Lee, 2005). By achieving the required level of strength endurance, an archer becomes capable of executing proper technique, which allows them to achieve top results during long training sessions or competitions.

A key challenge in reaching the necessary level of strength endurance lies in proper testing, well-designed training, and the structured periodicity of micro, meso, and macro cycles, all tailored to each archer through a personalized training plan. Given that archers need to shoot for 5–7 hours daily (300–500 arrows per day), they must also be aware of and motivated for an additional hour of strength endurance training, which is highly demanding and exhausting. In this context, it is essential to balance the needs and the actual physical fitness level of the archer to create a realistic and effective training plan

METHOD

The study employed a bibliographic-speculative method, as no classical observational studies existed. Through observations and participation in numerous seminars and training camps, it was noted that all data collected from bibliographic sources remain relevant and that no significant changes in the self-training process have occurred over time. These findings, combined with the expertise of physical preparation specialist Srđan Milosavljević, WA Level 3 national coach Miljko Čolović, and WA Level 2 coach Miljan Radičević, have been synthesized and interpreted in this study.

WA coach Peter Suk conducted five seminars and training camps (organized by the Archery Federation of Serbia between 2015 and 2016). Notably, he won a team gold medal with the Italian men's team at the 2012 Olympic Games, where he presented the methods discussed in this study (Olympics, 2012; World Archery, 2013; Vasić, 2015).

WA coach Kisik Lee presents these methods and insights in his books, *Total Archery* (2005) and *Inside the Archer* (2009), as well as on his website.

WA coach Hyung Tak Kim provides similar information and methods in his book Archery (2009).

Additionally, insights from the *World Archery* (WA) seminar (WA being the international federation for Olympic and Paralympic archery) conducted by WA coach Miljko Čolović (Level 1 in 2011 (10 days), 2015 (19 days), 2017 (9 days), and 2021 (9 days), as well as Level 2 in 2015 (9 days), 2017 (9 days), and 2020 (9 days)) should be considered. The information gathered aligns with findings presented by Suk, Lee, Kim, Kaminski, and DeBond.

Taking into account the training concepts proposed by Suk, Lee, Kim, and others, these methodologies were analyzed and synthesized into practical work with archers from Serbia (Čolović). This led to the idea (Radičević) of combining the two previously mentioned training concepts, with the assumption that this synthesis would yield better and more precise results. The details of this approach are presented in the chapter "Third Criterion".

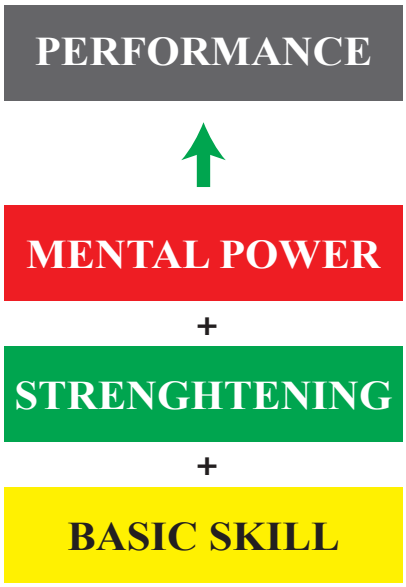
Modern competitive Olympic recurve bows have significantly lower draw weights—2 to 3 times less—ranging from 42 to 56 lbs (185–250 N). Compared to medieval bows, they are manufactured using cutting-edge designs and composite materials such as carbon, foam, aluminum, etc.

The need for exceptional shot accuracy at long distances (70m), the high volume of arrows shot per training session (300–500 or more), the 5–6 hours of effective shooting, six times a week, over an extended period (a year or more), creates a strong demand for exceptional physical fitness—particularly strength endurance —for every archer.

As a result, it becomes necessary for archers to continue working on strength, endurance, and especially strength endurance, even during the preparation and competition periods, albeit with a reduced workload. Of course, this must be balanced with the other three key aspects of archery: well-tuned and high-quality equipment, shooting technique, and mental stability and strength.

The importance of physical fitness in achieving results was also emphasized in the previously mentioned seminars by the renowned Korean coach Peter Suk, who highlighted physical fitness as a priority, placing it immediately after fundamental skills such as coordination (Figure 1).

Figure 1. *Sequence of stages in achieving performance*



Source: Suk, 2015

Before starting a training cycle, it is essential to conduct an initial assessment of archery candidates to determine their current physical fitness status. Based on the test results, archers should be categorized into groups, with training programs tailored accordingly. In the broadest sense, these exercises can be applied to beginners (who should start with lighter weights but not reduced training volume), intermediate-level archers, and elite competitors. This universality and structured approach (applicable to all skill levels, age groups, and populations) is one of the key advantages and benefits of this concept.

TESTING

In this context, the coach plays a crucial role during the training period by:

- testing the athlete (physically, technically, and mentally—focus),
- developing a training plan in collaboration with the athlete (personalization),
- iplementing the plan,

- adjusting the plan over time,
- monitoring and analyzing the implementation,
- ensuring the fulfillment and achievement of the plan.

Within that plan, and in accordance with this paper, it is necessary to draft a development plan for:

- strength,
- endurance, and
- particularly, strength endurance.

This analysis focuses on strength endurance exercises. By definition, these are activities that require prolonged muscle exertion without a decrease in work efficiency.

Strength endurance manifests in two primary forms:

1. Dynamic endurance, which is typical for repetitive movements performed at a relatively low speed, and
2. Static endurance, which is related to maintaining a competitive position during sporting activity (Perić, 2011).

Initially, it is primarily necessary to determine the maximum strength for a given load in relation to the number of repetitions performed (dynamic form) of general physical fitness. The number of repetitions leading to failure is not counted. The measurement of basic physical fitness consists of the following segments:

- 100m sprint, sit-ups (plank), push-ups, pull-ups, handgrip strength, back flexibility, and shoulder flexibility.
- The calculation should be performed based on the following Table 1.

Table 1. *Calculation of % maximum in relation to the number of repetitions*

% of maximum	Number of possible repetitions per single set
100.0	1
95.0	2
92.5	3
90.0	4
87.5	5
85.0	6
82.5	7
80.0	8
77.5	9
75.0	10
72.5	11
70.0	12

Source: Stojiljković et al., 2012

Specific measurements, according to three criteria of the current physical fitness of the archer, indicate whether the archer is capable of controlling their bow and whether it is necessary to increase or decrease the bow's strength:

The first criterion is how many arrows the archer – competitor can shoot daily/weekly without disrupting the proper process of executing the shooting cycle.

- Volume Guidelines (Rogue Archery TV, 2023):
  - < 24 lbs -> 400-600 arrows/week
  - Up to 30 lbs -> 600-800 arrows/week
  - Up to 36 lbs -> 800-1000 arrows/week
  - Up to 40 lbs -> 1000 or more arrows/week
  - 40 lbs -> 1800-3000 or more arrows/week
- Minimum 150 arrows per day (~1000 arrows/week) without any loss of form or signs of tremors.

- At the beginning of the training cycle, 180 arrows per day, gradually increasing to 300, 400, and 500 as the maximum daily number of arrows, depending on the phase of the training cycle (Kaminski, 2017).
  - Maximum 100 arrows per day for children up to 13 years of age and younger (Kaminski, 2017).

The second criterion is SPT exercises (Lee, 2005) and Kim (2009) for measuring physical fitness in relation to the archer's current bow strength. The archer performs the exercise with their bow, without an arrow:

- Long static – endurance: 30"-1' x 10, with an interval recovery time twice as long as the draw. The exercise should be performed in 3-5 sets, with 2-3' of recovery time. If the archer can hold the proper position for more than 45" during the exercise, it indicates that the archer controls their bow and can increase the bow's strength by 2-3 lbs, provided that the shooting cycle technique is not disrupted.
- Short static – strength: 3-5" in full draw, return to pre-draw position, and then go back to full draw. The exercise should be performed in 5-12 repetitions, in 3-5 sets, with 3-5' of recovery time. Perform the exercise for 30'.
- The archer draws the bow to the anchor position and holds it for 7" without losing form, then returns to the "set-up" position for 2". If the archer can repeat the exercise 8 to 9 times, they have the necessary physical fitness for the bow strength they used during the exercise (Kim, 2009).

The third criterion is the proposed modality of the last exercise "short static strength" (Radičević), which directly measures the capacity of back tension (which is of exceptional importance for the archer) and the precision of the draw (Suk, 2017).

- After the archer draws the bow using an arrow, they must remain in the draw position with the tip of the arrow 1-2 mm (beginners ~5 mm) from the edge of the clicker, for at least 7". Then, they return the arrow to the "set-up" position at 2". The exercise should be repeated 8 to 9 times, in 3 sets, with 3-5' of recovery time. During this, the distance on the clicker must not change, decrease, or increase, and there must be no appearance of tremors or disruption of form during the technique.
- If the archer is unable to perform the exercise in the specified range, it is necessary to reduce the load, or the bow's strength, to a level at which they can perform the exercise, and vice versa. When increasing the bow's strength, it should not exceed a maximum of 2-3 lbs, and ideally 1 lb, especially when dealing with bows over 38 lbs.
- Since the exercise is done with an arrow, it should be performed in front of the target at a distance of 1-2 m maximum, for the safety of participants.

By performing this modified exercise intuitively and experientially (seminars, lectures, camps, training, literature, etc.), we assume the possibility of validly measuring the current physical fitness of the archer. This would provide a foundational basis on which an individual training plan for strength endurance could be created for any archer, regardless of age, gender, or category, which is the essence and universality of this paper. Additionally, it opens the way for future experimental measurements, which will be the subject of interest in a future study.

It is important to note that this exercise can and should also be used to train: precision (always within 1-2 mm), consistency (every time the bow is drawn, it is in the same position), and endurance (without any deviation) in the draw length, which is considered a skill of crucial importance for top Korean archers.

DEVELOPMENT PLAN

When developing strength endurance:

- Do not use loads greater than 50% of the maximum muscle strength for the given position and the appropriate contraction regimen, i.e., use low resistance.
- The rule for the number of repetitions in a single set, depending on the size of the load:
  1. Moderate resistance (65-75%) – 8-12 repetitions
  2. Medium resistance (50-65%) – 13-18 repetitions
  3. Low resistance (25-50%) – 19-25 repetitions

For the development of strength endurance, only modern sports training should be used, which includes:

- Interval method, consisting of repeating movements with a load between 25% and 50% of the maximum measured power, at a medium pace, with 19-25 repetitions.
- Repeated movements are performed in several sets, most commonly 6-10, depending on the size of the resistance and the athlete's initial level of fitness (Health Club, 2012).

The plan for implementing strength endurance development needs to be divided into cycles:

- Microcycle - Weekly Plan (Table 2):
  - Which days the exercises are performed
  - Which exercises are performed and at what time
  - The volume and intensity of training
- Mesocycle - Monthly (1-3 months) Plan (Table 3):
  - Weekly schedule, methodology, and periodization
- Macrocycle - Seasonal Plan (Table 4):
  - The percentage of physical exercises in relation to other training segments

Table 2. *Example of a strength development training plan during the preparatory period, on a weekly level – microcycle*

Below is a typical Korean training program

Items	Contents	Reps/week	Remarks
Power	Weight Training	2 - 3	Winter 3 sessions/wk; Season 2 sessions/wk
Endurance (whole body)	Cross-country 2 Track run	1 - 2 6	W 2 sessions/wk; S 1/wk 2-3 km, Wed 8km
Flexibility	Streching Swimming	6 1 - 2	Winter 2/wk Season 1/wk
Agility	Gymnastic Aerobic dancing Ball games	1 6 1 - 2	Winter 2/wk Season 1/wk
Specific Physical Training of technique	SPT	3	Training with Bow (A,B,C types)

Source: Lee, 2005

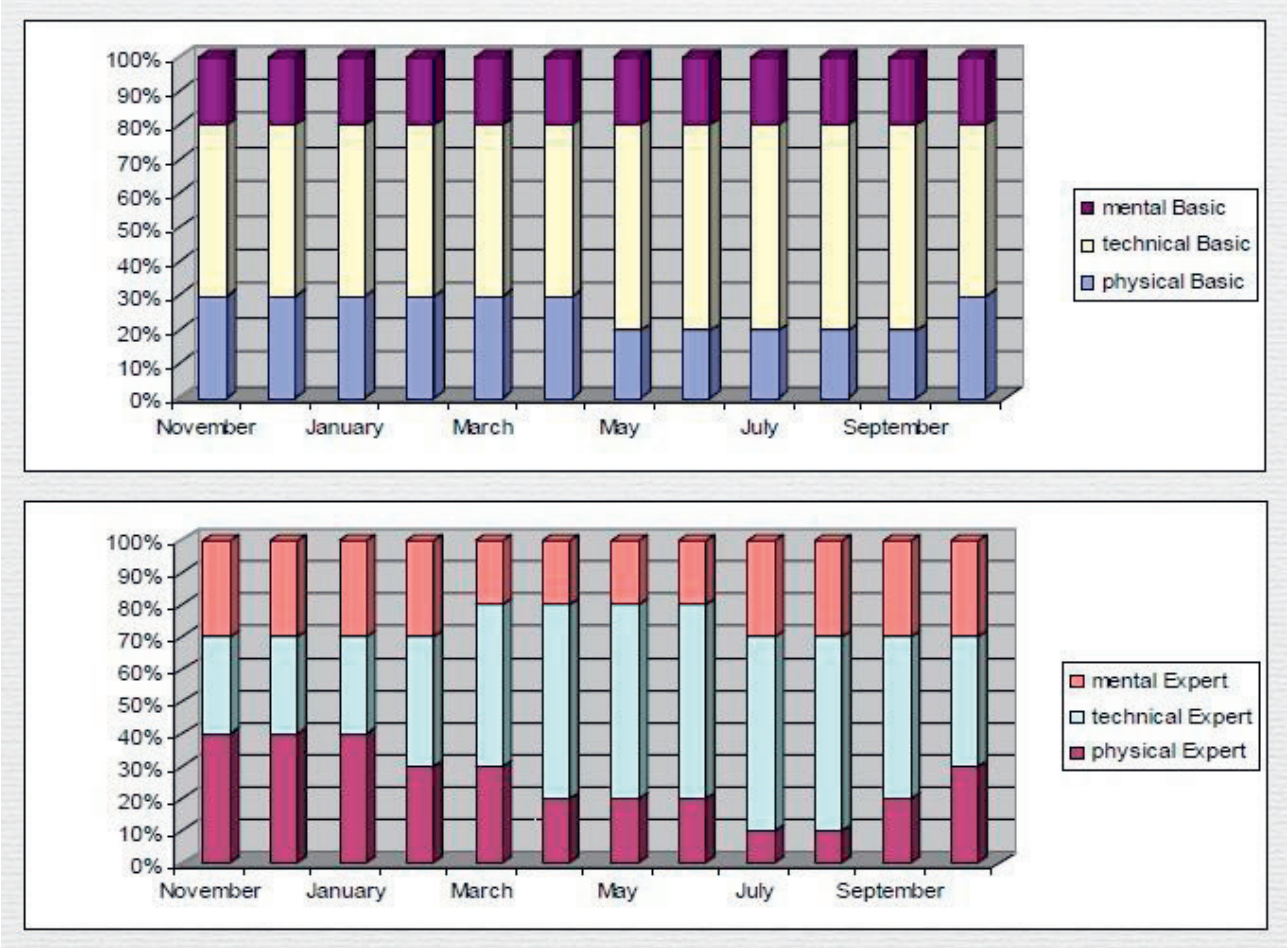
Table 3. *Example of a 12-week program – mesocycle*

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Week 1 Base			150 LIFT	108	215 LIFT	65 Recovery	161 LIFT
Week 2 +10%	97		168 LIFT	120	240 LIFT	72 Recovery	180 LIFT
Week 3 +20%	108		189 LIFT	135	270 LIFT	81 Recovery	202 LIFT
Week 4 Recovery-25%	121		112 LIFT	80	160 LIFT	45 Recovery	120 LIFT
Week 5 Base	72		175 LIFT	125	250 LIFT	75 Recovery	188 LIFT
Week 6 +10%	112		196 LIFT	140	280 LIFT	84 Recovery	210 LIFT

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Week 7 MAX +20%	125		210 LIFT	150	300 LIFT	90 Recovery	225 LIFT
Week 8 Recovery -25%			126 LIFT	90	180 LIFT	54 Recovery	135 LIFT
Week 9 Base	81		161 LIFT	115	230 LIFT	69 Recovery	173 LIFT
Week 10 +15%	104		189 LIFT	135	270 LIFT	81 Recovery	202
Week 11 Taper -25%	121	Recovery	123	88	175 Travel	53 Peak Ranking	131 Peak Ranking
Week 12 Competition	79 Peak Elimination	Peak Travel	Peak	Peak	Peak		

Source: Kaminski 2017

Table 4. *Example of the relationship between strength training, technique, and mental abilities – macrocycle*



Source: Suk, 2015

RESULTS AND PLAN IMPLEMENTATION

Although the proposed training plans have not been confirmed by experimental measurements (in Serbia), it is assumed that they will lead to or result in better archery performance, which will be the subject of a future scientific study, rather than this professional paper.

By respecting standard methods for developing strength endurance, it is essential to consider all the specificities of archery and the physical demands placed on the archer. Therefore, a concept is proposed that, at least for now, has proven to be the most effective in practice.

With this training concept, renowned coaches Kim (Korea and Taiwan national team) and Lee (Australia and USA) have won numerous medals in the Olympic Games and other competitions.

Peter Suk, as the coach of the Italian archery team, won the team gold medal at the Olympic Games. He was recognized by World Archery as the most successful development coach in archery (Mackay, 2009).

Taking into account everything stated so far, the proposed training concept for archers who aim for top results and performance currently represents the foundational training matrix from which it can be adjusted more or less in terms of personalization. However, fundamentally speaking, greater deviations from this model only lead to poorer results.

Due to the development of the basic body platform (core), reduced risk of injuries, faster recovery, stress relief, achieving the same load with less effort, and minimizing the effects of asymmetry in archery, the following exercises are proposed to achieve overall physical fitness (Table 5, Figure 2):

Table 5. *Set of recommended basic exercises for strength building*

No.	EXERCISE DESCRIPTION	LOAD	REP./SET	HOLD	INTERVAL
1	Parallel dumbbell raises	4kg	8 x 3	3 sec	1 min
2	Dumbbell raises at 45°	4kg	8 x 3	3 sec	1 min
3	Dumbbell raises at 90°	4kg	8 x 3	3 sec	1 min
4	Bent-over parallel extension	4kg	8 x 3	3 sec	1 min
5	Bent-over parallel extension at 45°	4kg	8 x 3	3 sec	1 min
6	Plank	own	1 x 3	1 min	1 min
7	Pull-ups	own	12 x 3	1 sec	2-3 min
8	Back extensions	own	12 x 3	3 sec	1-2 min
9	Back extensions on a ball	own	12 x 3	3 sec	1-2 min
10	Hand grip (~ 50 kg – 95 %)	own	12 x 3	1 sec	1 min
11	Push-ups	own	100	1 sec	-
12	Burpee–from staning to push-up position-squat-jump	own	20 x 3	-	2-3 min
13	Running in Zone 2, last 100m in Zone 4	2-4 km	3/week	-	-

Instructions for performing exercises:

- In the initial phase of training, warm up for 5-10', perform the main part of the workout for about 45', and finish with relaxation and stretching for 5-10'.
- Perform exercises 3 times per week during the preparation phase, and 1-2 times per week during the competition season.
- Do a higher number of repetitions, 19-25 repetitions, with full range of motion, in order to maintain flexibility and simultaneously increase strength.
- erform 2-3 sets of blocks, with each block consisting of 5-6 sets. If 3 blocks are performed, then do 3-4 sets. Recovery time should be 2 times longer than the duration of the exercise. The break between blocks should be 5-6'.
- Start exercises with the lower body, focusing on the legs.
- Perform at least one push exercise and then one pull exercise.
- Include exercises for the core to gain stability for archers (e.g., in windy conditions).

Figure 2. *Graphic representation of the exercises listed in Table 5*

Exercises for developing strength endurance should be performed with low resistance (30-50%) – 19-25 repetitions.

For strength endurance exercises with the bow and without an arrow, perform the following exercises:

Specific – SPT (Specific Physical Training), daily (min. 3 times per week during the competition period), lasting about 1 hour:

- **Endurance**: 30”-1’ for 10 repetitions, with an interval recovery time twice as long as the draw. If the archer holds the bow at full draw for 30”, the recovery time is 1’. The recovery time is 2-3’. Perform the exercise in 3-5 sets with a 2-3’ break between sets.
  If the archer can hold the position for more than 45” without breaking form, this indicates that the archer should increase the bow strength by 2-3 lbs.
- **Strength**: 3-5” at full draw (anchoring), return to the "set-up" position, then go back into full draw (anchoring). Perform the exercise for 5-12 repetitions in 3-5 sets, with 3-5’ of recovery time. Perform the exercise for 30’.
- **Flexibility**: Draw the bow for 10” and pull the arrow over the clicker 1.0-1.5 cm higher, without firing the arrow (practice near the target for safety). Perform the exercise for 6 repetitions and 5 sets, with 30” of recovery time between repetitions and 2-3’ of recovery time between sets.
- **Structure**: Draw the bow behind the back with the goal of allowing the archer to feel the muscle structure (proprioception), which is important for proper technique, as well as ensuring the archer is properly warmed up and prepared for competition.

Precision and draw capacity: as a substitute for the previous exercise, the following can be used to practice "strength":

- After the archer draws the bow (anchoring) using an arrow, in the correct form, they should stay at full draw with the tip of the arrow 1-2 mm (5 mm for beginners) from the edge of the clicker for at least 5-7”. After a pause, return the arrow to the "set-up" position, max. 2-5”. The exercise should be repeated at least 8-9 times, in 3 sets, with 3-5’ of recovery time. Throughout the exercise, the distance on the clicker should not change, decrease, or increase, and no tremors or form disruptions should occur.
- If the archer is unable to perform the exercise within the specified range, the load or bow strength should be reduced to a level where they can perform the exercise, and vice versa. In case of increasing the bow strength, it should not exceed a max. of 2-3 lbs, and preferably 1 lb, especially when the bow strength exceeds 38 lbs.
- Since the exercise is performed using an arrow, it should be done in front of the target at a distance of 1-2 meters max. for the safety of the participants.

These exercises should be practiced daily (at least 3 times a week during the competition season), for an hour (Kisik Lee Online, n.d.).

Bow draw with shoulder exercises for proprioception – kinesthesia or the awareness of movement and body position in space

Proprioception is the ability of the movement execution system to adapt and perform correct movements in response to specific static and dynamic stimuli. Proprioception involves the awareness of the position of one's body and limbs in space. Proprioceptive exercises are an essential part of preparatory training. Another term for these exercises is PVV (Proprioceptive-Vestibular-Visual), emphasizing the importance of the interplay between proprioceptors in the muscles, the balance center in the inner ear, and vision.

Exercise guidelines: Perform daily, at least 3 times per week, but no longer than 10 minutes continuously to prevent a decline in neuromuscular sensitivity. Engage as many senses as possible (visual, auditory, tactile, etc.), perform with both open and closed eyes, progress from static to dynamic, slow to fast, easy to difficult, and on both stable and unstable surfaces.

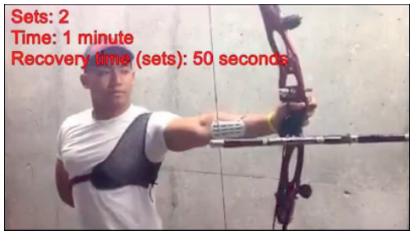
Illustration of Isometric and Dynamic Exercises (YouTube, 2025, July 4 b):

1. Exercise: **Dynamic repetition (concentric-eccentric, very slow).**
   Sets: 4
   Repetitions: 8 (draw – 5 sec, release – 5 sec).
   Recovery time: 40 sec (total exercise duration: 440 sec. – 7.33 min).
   Phase images:

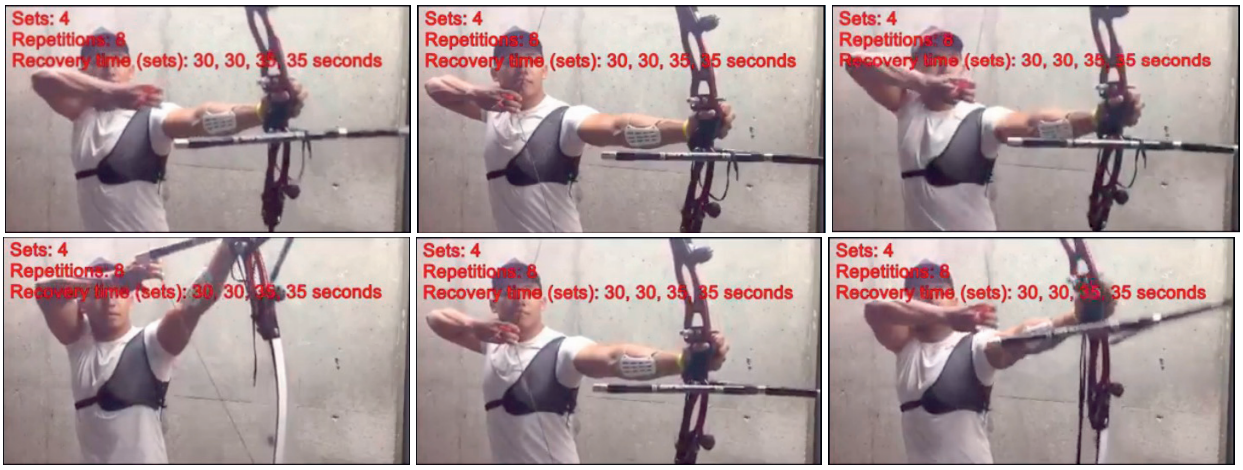
2. Exercise: **Dynamic repetition (eccentric – fast draw, slow release).**
   Sets: 4
   Repetitions: 8 (fast draw - 1 sec. release- 5 sec).
   Recovery time: 40 sec. (total exercise duration: 312 sec. – 5,20 min)
   Phase images: Same as above

3. Exercise: **Dynamic repetition (concentric – slow draw, fast release).**
   Sets: 4
   Repetitions: 8 (slow draw - 5 sec, release - 1 sec.).
   Recovery time: 40 sec. (total exercise time: 312 sec – 5,20 min).
   Phase images: Same as above

4. Exercise: **Isometric arm contraction (without drawing the bowstring)**
   Sets: 2
   Duration: 1 min.
   Recovery time: 50 sec. (total exercise duration: 170 sec. - 2,83 min).
   Phase image:



5. Exercise: **Dynamic repetition by raising the front arm at a 45° angle before drawing the bowstring and lowering it to the shooting line with shoulder abduction.**
   Sets: 4
   Repetitions: 8 (draw- 4 sec. release- 1 sec).
   Recovery time: 30, 30, 35, 35 sec. (total exercise duration: 290 sec. - 4,83 min).
   Phase images:



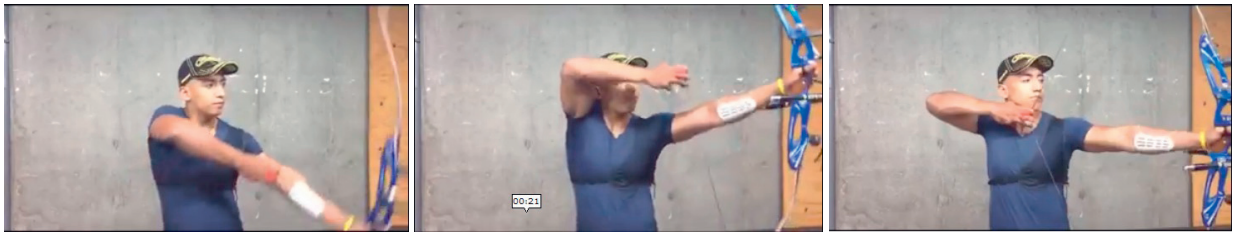
6. Exercise: **Isometric arm and shoulder contraction with elastic band (load ~ 1 - 2 kg).**
   Sets: 4
   Draw duration: 20, 25, 30, 35 sec.
   Recovery time: 35 sec. (total exercise duration: 215 sec. - 3,58 min).
   Phase images:

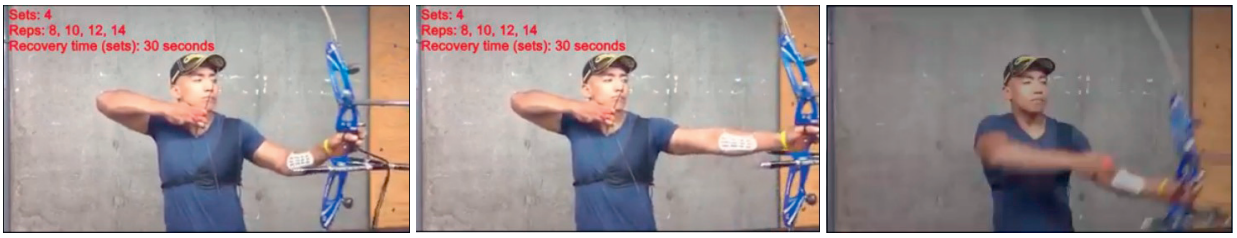
- Total duration of the workout is around 29 min.
- Recovery time between exercises are 5 X 5 min. = 25 min.
- **Total: ~ 55 min.**

Strength exercises for the scapulae with bow drawing (YouTube, 2025, July 4 a):

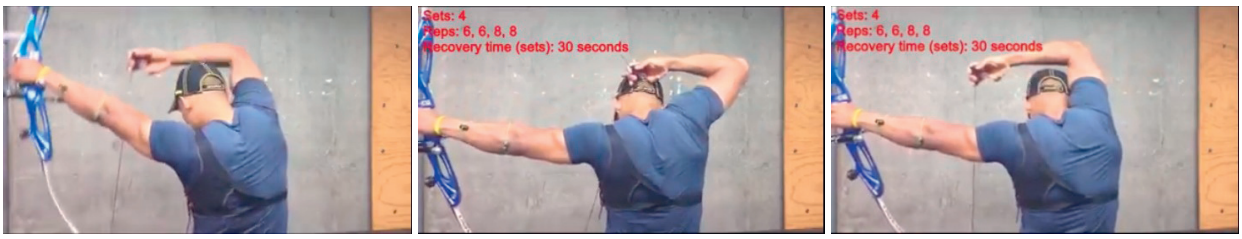
1. Exercise: **Bow drawing, isometric contractions.**
   Sets: 5
   Draw duration (seconds): 15, 20, 25, 30, 35
   Recovery time (between sets): 30 sec.
   Phase images:

2. Exercise: **Bow drawing, elbow flexion and extension.**
   Sets: 4
   Repetitions: 8, 10, 12, 14 (elbow pull 1 sec., push 1 sec).
   Recovery time (between sets): 30 sec.
   Phase images:





3. Exercise: **Bow draw, with the string grip behind the head.**
   Sets: 4
   Repetitions: 6, 6, 8, 8 (draw 1 sec. release 1 sec).
   Recovery time (between sets): 30 sec.
   Phase images:



4. Exercise: **Bow draw, scapular abduction.**
   Sets: 4
   Repetitions: 10, 10, 12, 12 (scapular draw 1 sec. releaase 1 sec)
   Recovery time (between sets): 35 sec.
   Phase images:

5. Exercise: **Dynamic repetitions.**
   Sets: 5
   Repetitions: 6, 8, 10, 12, 14 (draw 1 sec. release 1 sec).
   Recovery time (between sets): 15, 20, 25, 30, 35 sec.
   Phase images:

- Total workout time is around 17,3 min.
- Recovery time between exercises is 4 X 5 min. = 20 min.
- **Total: ~ 37,5 min.**

Measurements of bow strength, repetitions, and the number of sets in relation to correctly executed technique should be conducted on a weekly and monthly basis to assess potential progress or stagnation. Based on the results, any necessary adjustments to bow strength should be made.

It is necessary to record the conditioning status results at the beginning and after 60 days under controlled conditions. Keeping a documented record of the number of training sessions and the fulfillment of the planned schedule is also necessary.

Throughout the process, the archer's results during training and competitions should be continuously tracked and monitored. After the designated preparation period, the results should be commented on and presented in a future study.

Any improvements in results, time, and testing should be recorded in relation to gender, age, and starting conditions.

DISCUSSION

All the information presented in this study unequivocally highlights the importance and necessity of implementing the described exercises to develop strength endurance during the preparatory period and later to maintain the achieved level of physical fitness, ultimately aiming for higher archery performance.

The exercises, both with and without the bow, outlined in the previous section, have been designed and structured according to the specific demands of archery. Their purpose is to develop the specific muscle groups essential for correctly executing the shot cycle over time without loss of motor function in archers.

This approach ensures the required consistency, which, along with proper execution of the shot cycle technique, enables high-level performance in competitions.

As highlighted in this study, special attention should be given to:

- The general physical fitness of archers to prevent the effects of the sport's inherent asymmetry.
  - In the initial phase of training, warm-up for 5-10 minutes; in the main part of the training, perform exercises for about 45 minutes; and in the final phase, cool down and stretch for 5-10 minutes.
  - Perform exercises 3 times per week during the preparatory period and 1-2 times per week during the competition season.
  - Execute 19-25 repetitions with a full range of motion to maintain flexibility and increase strength.
  - Perform 2-3 blocks of sets. A block consists of 5-6 sets or 3-4 sets successively. The rest period between sets should be twice the duration of the exercise, and the break between blocks should be 5-6 minutes.
- SPT - Specific Physical Training should be performed daily (at least 3 times per week) for approximately 1 hour, focusing on endurance, strength, flexibility, and structure.
- "Modality", i.e., the combination of Suk and Lee exercises or tests, should be performed as described on page 5 and later in the paper, depending on its purpose.

In conclusion, it is important to highlight the possible and realistic limitations arising from the environment in which we work. Based on empirical knowledge, almost all archers in Serbia use bows that are too strong for their current physical fitness. The average archer’s shooting technique is at a low level and lacks consistency. This makes working in such an environment a challenge.

A small number of clubs in various cities, with archers of different skill levels, ages, and training levels, may result in the inability to form the necessary and required number of sampled groups (five), over a minimum period of three months.

Regardless of these limitations, which can also be seen as real challenges, it is recommended to conduct a future study to confirm the claims made in this paper. Such a study could also provide insight into the extent of the impact that the proposed exercises may have on archers’ accuracy, as well as generate new ideas or conclusions regarding these exercises.

CONCLUSION

This review aimed to highlight the importance of an archer’s physical fitness, particularly in terms of strength endurance.

The second objective was to present the methodology for measuring an archer's initial physical fitness, as well as to showcase key exercises, both with and without the bow, that should lead to improved conditioning, precision, and consistency—factors that would undoubtedly enhance competition results.

The "third criterion" is also the third objective of this work, which proposes a new test-exercise as a training modality based on the exercises suggested by Suk, Lee and Kim. This test is designed to directly measure back tension capacity (which is crucial for an archer) and draw precision (Suk, 2017). At the same time, these exercises should improve an archer's physical fitness, precision, and consistency. This approach should be seen as an innovation in archery training (details of the test-measurement exercise are provided on page 5 of this paper).

Intuitively and empirically (seminars, lectures, camps, training sessions, literature, etc.), it is assumed that this paper establishes a foundation for developing individualized strength endurance training plans for any archer (regardless of age, gender, or category). This is the essence and universal value of this study, as well as a stepping stone toward future experimental research, which will be the subject of further study.

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