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# Patellar Mobility in Elite Swimmers of Jorhat Swimming Society: A Cross-Sectional Study

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**_Abstract_**

***Background:*** *Patellar mobility is vital for swimmers, affecting leg propulsion and injury risk. Understanding its role in swimming biomechanics enhances insights into knee stability and performance across different strokes.* ***Aim:*** *To assess patellar mobility in elite swimmers of Jorhat Swimming Society, Jorhat, Assam.* ***Purpose:*** *To explore the relationship between patellar mobility and swimming stroke styles, specifically focusing on knee biomechanics during the stroke.* ***Methodology:*** *A cross-sectional study involving 27 elite swimmers from Jorhat Swimming Society. Participants provided informed consent. The patella glide test was conducted to measure mobility, using a tape measure to record distances from the midpatella to the medial and lateral femoral epicondyles at 20° of knee flexion.* ***Results:*** *Analysis at a significance level of 0.05 revealed that the left patella had greater inferior mobility than the right (p=0.043). ANOVA showed significant differences in mobility across stroke styles, with hypomobility prevalent in superior and inferior directions (p=0.022). Backstroke and freestyle swimmers generally exhibited consistent patella mobility, ranging from 0.5 to 1.5 cm.* ***Conclusion:*** *This study shows variations in patellar mobility among elite swimmers, highlighting injury risks and the need for targeted interventions.*

**Keywords:** Patellar mobility, elite swimmers, breaststrokers, knee pain, knee flexion

## INTRODUCTION

Patella mobility, or the movement of the kneecap, is crucial for swimmers due to the repetitive kicking motion involved in swimming strokes. Strong and stable patella mobility ensures efficient leg propulsion and reduces the risk of injury. Swimmers often focus on exercises that strengthen the quadriceps, hamstrings, and surrounding muscles to support proper patella movement and overall knee function [1].

In normal knee, patella can be displaced medially, laterally, approximately 1 cm in each direction which is 25% of the width of the patella and distance of more than 2 cm is believed nearly always associated with patella instability [2]. Understanding the nuanced interplay between patella mobility and swimming biomechanics offers insights into injury prevention, stroke optimization, and overall athletic performance. This exploration delves into the role of patella mobility in different swimming strokes, shedding light on its impact on knee stability, propulsion efficiency, and stroke mechanics. By examining the specific demands placed on the patella in each stroke, we can better appreciate its significance in the dynamic and complex movements of competitive swimming.

## OBJECTIVE

To assess the patellar mobility of the elite swimmers of Jorhat Swimming Society, Jorhat,

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Assam. Given the limited number of studies in this area, this research aims to investigate the relationship between patella mobility and swimming stroke styles, specifically focusing on the implications for knee biomechanics during the stroke.

## METHODOLOGY

The data collection for the study was conducted at the Jorhat Swimming Society, focusing on a population of elite swimmers. A sample size of 27 elite swimmers aged above 15 years, were selected using convenient sampling within a cross-sectional study design. Before the study commenced, all participants were informed about its nature and purpose, and written informed consent was obtained. The procedure involved performing the patellar glide test, which measured the distance from the midpole of the patella to both the medial and lateral femoral epicondyles with the knee flexed at 20°. A measuring tape was utilized to accurately record the distances from the midpatella to the lateral and medial femoral epicondyles.

## STATISTICAL ANALYSIS

Tables 1–3 provide an in-depth analysis of average mobility across various stroke styles, with data segmented by glide movements (right and left) and gender. Table 1 shows that for the backstroke, breaststroke, butterfly, and freestyle, mobility values generally remain consistent between right and left glide, though slight differences exist, particularly in medial and inferior movements, with some stroke styles (e.g., breaststroke) showing higher left-side values. Table 2 further explores these differences by gender, revealing that females tend to exhibit slightly higher mobility, especially in medial and inferior movements, compared to males. Table 3 complements this by presenting the variance and standard deviation, indicating the spread and consistency of the mobility data for each stroke style. Overall, the data highlights the influence of stroke style and gender on mobility, with minor variations in right and left glide movements and notable gender-based differences in mobility.

**Table 1.** Average Mobility in between groups.

| **Mean** | | | |
|---|---|---|---|
| ***Stroke Style*** | ***Glide*** | ***Right*** | ***Left*** |
| Backstroke | Medial | 1.38 | 1.20 |
| | Lateral | 1.30 | 1.13 |
| | Superior | 0.93 | 0.88 |
| | Inferior | 0.93 | 0.93 |
| | | | |
| Breaststroke | Medial | 1.33 | 1.51 |
| | Lateral | 1.21 | 1.13 |
| | Superior | 0.76 | 0.94 |
| | Inferior | 0.73 | 1.07 |
| | | | |
| Butterfly | Medial | 0.77 | 1.02 |
| | Lateral | 1.08 | 0.95 |
| | Superior | 0.85 | 0.72 |
| | Inferior | 0.85 | 0.92 |
| | | | |
| Freestyle | Medial | 1.28 | 1.38 |
| | Lateral | 1.00 | 1.18 |
| | Superior | 1.20 | 1.28 |
| | Inferior | 1.20 | 1.20 |

 

**Table 2.** Average Mobility by Gender.

| Mean | | | |
|---|---|---|---|
| **Gender** | ***Glide*** | ***Right*** | ***Left*** |
| Female | Medial | 1.22 | 1.41 |
| | Lateral | 1.21 | 1.16 |
| | Superior | 0.86 | 0.87 |
| | Inferior | 0.89 | 1.00 |
| | | | |
| Male | Medial | 1.18 | 1.23 |
| | Lateral | 1.08 | 1.02 |
| | Superior | 0.92 | 1.03 |
| | Inferior | 0.86 | 1.00 |

**Table 3.** Variance and Standard Deviation by Stroke Style.

| Stroke style | Glide | Variance | | Standard deviation | |
|---|---|---|---|---|---|
| | | ***Right*** | ***Left*** | ***Right*** | ***Left*** |
| Backstroke | Medial | 0.23 | 0.39 | 0.48 | 0.62 |
| | Lateral | 0.16 | 0.19 | 0.40 | 0.43 |
| Breaststroke | Medial | 0.17 | 0.42 | 0.42 | 0.64 |
| | Lateral | 0.31 | 0.20 | 0.56 | 0.45 |
| Butterfly | Medial | 0.14 | 0.21 | 0.38 | 0.45 |
| | Lateral | 0.34 | 0.36 | 0.58 | 0.60 |
| Freestyle | Medial | 0.18 | 0.36 | 0.42 | 0.60 |
| | Lateral | 0.38 | 0.21 | 0.61 | 0.46 |

**Table 4.** Paired ‘t’ Tests (Right vs. Left Patellar Mobility).

| Glide | t-value | p-value |
|---|---|---|
| Medial | –1.30 | 0.205 (no significant difference between right and left) |
| Lateral | 0.59 | 0.558 (no significant difference) |
| Superior | –1.25 | 0.223 (no significant difference) |
| Inferior | –2.13 | 0.043 (significant difference, suggesting left patella has greater inferior mobility to right) |

## Correlation Between Different Mobility Directions

### *Right patella*

- Strong correlation between superior right and inferior right mobility (0.84), indicating that swimmers with high superior mobility tend to have high inferior mobility.
- Low correlation between medial right and other directions.

### *Left patella*

- Strong correlation between superior left and inferior left mobility (0.63) and also between medial left and superior left (0.47) (Table 4).

## RESULT

The statistical significance level was set at p<0.05 for the analysis. A paired t-test was conducted to assess the mobility between the left and right patellae. The left patella exhibited greater inferior mobility than the right patella (p-value=0.043). ANOVA was performed to evaluate the mobility across different stroke styles, revealing significant variation in superior and inferior mobility among stroke types, while medial mobility showed borderline significance (Table 5). This indicates that hypomobility is more prevalent, particularly in the superior and inferior directions (p-value=0.022). Backstroke and freestyle swimmers tend to demonstrate more consistent patella mobility, typically ranging between 0.5 and 1.5 cm.

## DISCUSSION

In this research, the primary aim was to assess patellar mobility in elite swimmers and investigate whether any potential relationship exists between patellar mobility and swimming stroke style. The study involved a total of 27 elite swimmers, categorized into different stroke disciplines: 12 breaststroke swimmers, 4 backstroke swimmers, 6 butterfly swimmers and 5 freestyle swimmers. The findings of this study support the relationship between abnormal patellar mobility and altered biomechanics associated with different stroke styles (Figures 1 and 2). The data revealed notable variations in patellar mobility between breaststroke, backstroke, and freestyle swimmers. Specifically, breaststroke swimmers exhibited greater variability in patellar mobility compared to the other stroke types, with a significant disparity in inferior mobility between the left and right patella. These results suggest a potential biomechanical imbalance, asymmetrical movement patterns or muscular imbalances, particularly in breaststroke swimmers, which could contribute to the medial knee pain commonly observed in this population [2, 3].

**Table 5.** ANOVA (Across Stroke Types for Right Side Mobility).

| Glide | F-value | p-value |
|---|---|---|
| Medial | 3.03 | 0.050 (just below significance level, implying some variation between stroke types) |
| Lateral | 0.28 | 0.837 (no significant difference across stroke types) |
| Superior | 3.87 | 0.022 (significant difference, specially between strokes like backstroke and breaststroke) |
| Inferior | 4.73 | 0.10 (significant difference across strokes) |

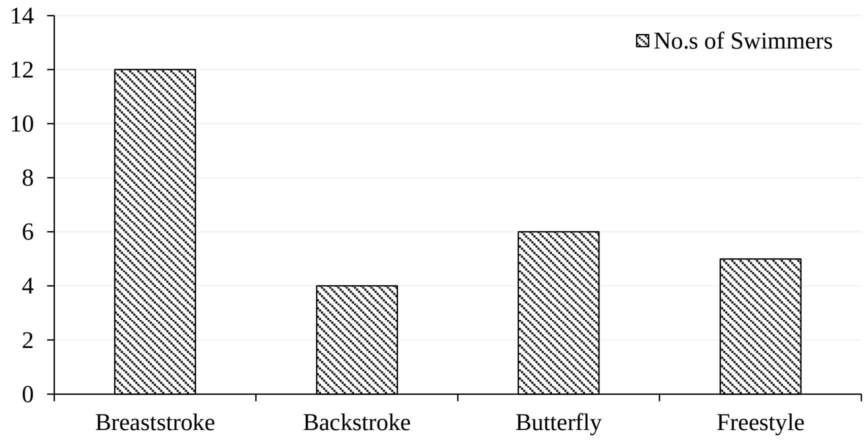


**Figure 1.** Total numbers of swimmers who participated in each stroke style.

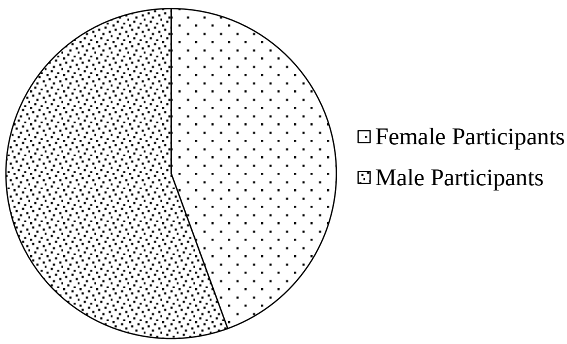


**Figure 2.** Gender distribution.

 

Breaststroke swimmers have shown more variability in patella mobility, with some showing higher lateral and medial mobility. The "breaststroke" is a swimming technique where the swimmer is positioned face down, using a semicircular motion for the arms and a frog kick for the legs. The heel is drawn towards the buttocks, with the knees bent, and then the legs kicked outward. The higher mobility may be due to the unique inward rotation and high pressure demands placed on the knee joints during the leg kick phase [4]. The stroke is linked to increased stress on the medial side of the knee, potentially causing Patellofemoral Pain Syndrome (PFPS) and medial knee pain, which raises concerns about imbalances that could increase the risk of patellofemoral joint stress and overuse injuries [5–8]. However, it is essential to consider that if the sample size had included more than 12 breaststroke swimmers, the results could have been notably different. A larger sample size might have revealed a broader range of patellar movement patterns and variations, potentially highlighting factors that contribute to mobility differences in this stroke.

The borderline significance in patellar mobility medially that may be hypomobile or hypermobile further highlights the complexity of patellar movement in this population, with some swimmers showing increased lateral and medial mobility that could contribute to altered tracking and stress on the knee joint (Figure 3).

A study done by Rondy *et al*. suggested that during biomechanical loading, the patella mobility may be increased because of poor hip strength ultimately leading to increased stress to the proximal patellar tendon [9].

Backstroke, butterfly and freestyle swimmers, on the other hand, had not demonstrated any significance in the patellar mobility. Hence, suggests that these stroke styles place more uniform demands on the patellofemoral joint, potentially reducing the likelihood of imbalances or injury. Patellar mobility could have clinical significance and warrants further investigation to determine if it is a risk factor for patellar tendinopathy. Ultimately, the main objective of evaluating patellar mobility is to detect any abnormalities. Assessing increased patellar mobility is also beneficial for evaluating patellar instability, as breaststroke swimmers may experience heightened risk of subluxation or dislocation during knee flexion and extension due to forces exerted on the knee, along with associated issues like patellofemoral pain [10, 11].

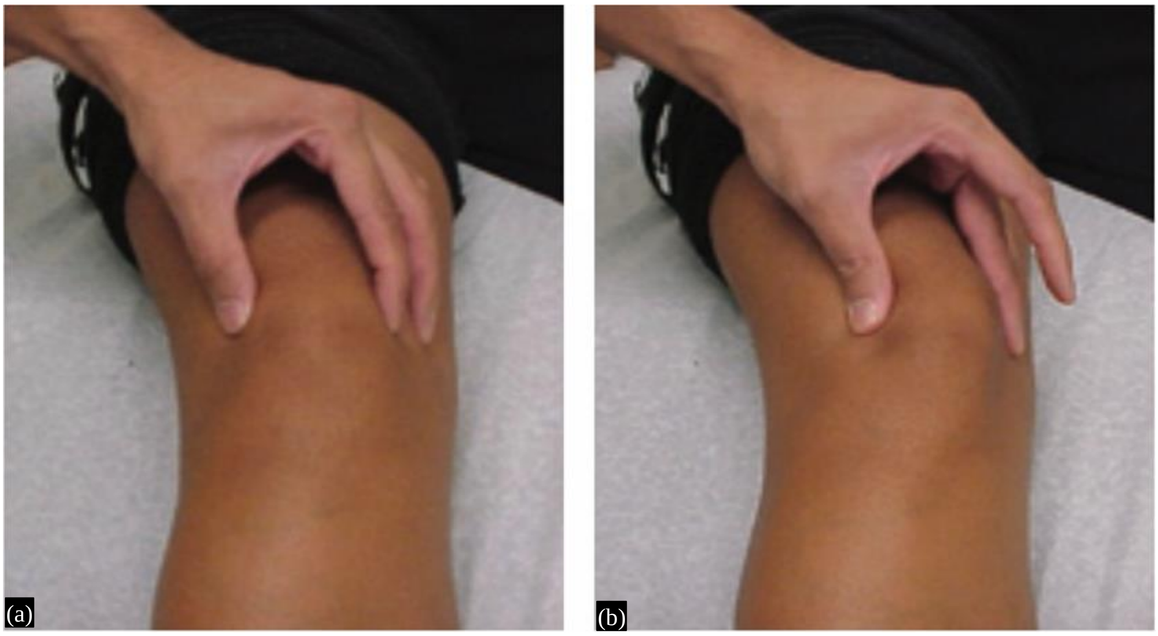


**Figure 3.** (a) Patellar mobility assessment Patella is grasped in the resting position, (b) translated medially.

 

Swimmers with hypermobility or hypomobility in the patella may experience abnormal patellar tracking, which can exacerbate joint stress and lead to conditions such as patellofemoral pain syndrome or medial plica irritation. Overall, the findings of this study underscore the importance of assessing patellar mobility in swimmers, particularly those specializing in breaststroke. Addressing biomechanical imbalances through targeted interventions such as strengthening and flexibility exercises, patellar taping, or manual therapy may help to reduce the risk of injury and improve performance. Future research should explore the long-term effects of these interventions on patellar mobility and knee health in swimmers, with a particular focus on identifying modifiable risk factors that could be targeted in injury prevention programs.

## CONCLUSION

This study reveals significant variations in patellar mobility among elite swimmers, particularly in breaststroke athletes. The left patella's greater inferior mobility compared to the right suggests potential asymmetries that may contribute to increased injury risk, especially medial knee pain associated with patellofemoral pain syndrome. Breaststroke swimmers showed more variability in mobility, likely due to the unique biomechanics of their stroke, while backstroke and freestyle swimmers exhibited more consistent patellar movement. These findings highlight the importance of assessing patellar mobility in swimmers, particularly those specializing in breaststroke. Targeted interventions focusing on strength and flexibility could help reduce injury risks and improve performance. Future research should explore the long-term effects of these interventions on knee health and identify modifiable risk factors for effective injury prevention.

### Recommendations

Future studies should aim for a larger and more balanced sample size across different swimming stroke styles to produce more concise results. Furthermore, comparing male and female swimmers will provide valuable insights into the differences in patella mobility and its impact on performance.

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