Knee surgery & Muscle weakness

Teacher notes

Diane got hurt playing soccer for her school and she needed knee surgery. She was shocked to find that after the surgery, her quadriceps (thigh muscles) were very weak in the leg that had surgery. Her physical therapist estimated that she only had 20% of her previous muscle strength in her quads in the affected leg. He assured her that this is a common occurrence after knee surgery. He also thought she’d recover about 20% of her strength each month she was in physical therapy, or PT. He concluded that she’d regain her strength in 4 months. Let’s investigate this claim.

1. If Diane has 20% muscle strength in her quads and gains 20% after one month of PT, what is her muscle strength at the end of the first month? Be sure to show how you determined this.

After one month of PT, Diane has 24% of her original muscle strength.

1. At the end of the first month Diane is kind of frustrated because she isn’t gaining strength as quickly as she thought she would. Based on your answer to #1, should she be worried? Explain your answer.

Diane should not be worried. The calculation shows that since she started will such a small percentage of muscle strength, 20%, and she increased that by 20%, giving her a total of 24%, a gain of only 4%. She will have to be patient and keep going to PT.

1. Diane is still worrying about when she will get back to 100% of her quad strength. Create a table that shows her muscle strength each month until she regains 100% of her strength.

|  |  |
| --- | --- |
| *m*  months since surgery | *S*  Muscle strength  (percent) |
| 0 | 20 |
| 1 | 24 |
| 2 | 28.8 |
| 3 | 34.56 |
| 4 | 41.472 |
| 5 | 49.766 |
| 6 | 59.720 |
| 7 | 71.663 |
| 8 | 85.996 |
| 9 | 103.196 |

1. Using the table in #3, find the change in the percentages from one month to the next. What do you notice?

|  |  |
| --- | --- |
| ∆*m* | ∆*S* |
| Month 0 → 1 | 4% |
| Month 1 → 2 | 4.8% |
| Month 2 → 3 | 5.76% |
| Month 3 → 4 | 6.912% |
| Month 4 → 5 | 8.294% |
| Month 5 → 6 | 9.954% |
| Month 6 → 7 | 11.943% |
| Month 7 → 8 | 14.333% |
| Month 8 → 9 | 17.200% |

Each month Diane gains a greater percent of muscle strength that the month before. Since we are working with percentages this makes sense. 20% of a small amount will be small. For example, 20% of 20% is 4%. While 20% of a larger percentage will be bigger. For example. 20% of 85.996% was an increase of 14.33%.

1. Write a function that will also find Diane’s muscle strength as a function of the number of months she’s spent in PT.
2. Based on your findings in #3, write an explanation to Diane that explains when you expect her to be back to 100%. In your explanation, include if you agree or disagree with her physical therapist.

Diane will be back to 100% of her original muscle strength at some time during month 8 of PT. The answer is . Students can use guess and check, a graph, or logarithms to find this answer.