



# The variables of force generation and application to cartilage, ligaments and bone remain to be defined

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The patellofemoral (PF) joint continues to evoke interest because it commonly generates vague complaints for which surgical treatments often result in completely unpredictable results. The terms anterior knee pain, patellar instability, patellar chondropathy or cartilage injury, and patellar maltracking lack precise definition. These terms, however, are often interchanged without reason and this imprecision makes communication and logical decision making impossible.

Multiple variables have been noted and assumed with little evidence to be responsible for PF pain or dysfunction (1,2). These variables must be measured in a valid, reliable and reproducible way. When multiple variables are acting simultaneously a complex equation exists and often the relative importance of each variable cannot be determined. Addressing the least important variable is a common mistake. Studies without precise measurement which exclude potentially important factors usually result in incomplete or incorrect conclusions.

Understanding this, we can consider the PF joint from 2 points of view, the forces which are exerted on the joint and the structures which are subjected to those forces. In the anterior knee, the principle force is the quadriceps muscle. The amount of force required by the quadriceps depends on the task at hand, the weight of the body and the length of the limb lever arms. The direction of the force depends on the underlying geometry of the skeleton, manifested as limb alignment, and the position of the skeleton in space relative to the body center of gravity. This position changes instantaneously with activity and we have no measurements of magnitude or direction of these changing vectors.

In the anterior knee the structures which are subjected to quadriceps force are the cartilage and bone of the patella and

trochlea, and the attached soft tissues including the medial and lateral PF, patellotibial, patellomeniscal ligaments and the patellar tendon. Surgery on PF cartilage or PF ligaments often fails if we do not address an abnormal quadriceps force which commonly is the result of abnormal limb alignment.

Future investigations integrating all of the variables of force, limb alignment, patellar and trochlear geometry and ligament mechanics, will be required before we have a rational approach to PF failure whether it is manifested as pain, instability, or arthrosis.

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## Footnote

*Conflicts of Interest:* The author has no conflicts of interest to declare.

## References

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