“Warped” is a term often (mis)used to describe any number of conditions associated with brake pedal pulsations, steering wheel shimmy, judder or any other vibrations that occur while applying the brakes.

Most brake pads rely on a friction transfer layer to the surface of the rotor in order to work properly. This is why we must generally perform some type of “bedding” or “break-in” to new pads and rotors before they will perform as intended. When the friction transfer layer is applied to - and maintained on - the rotor surface evenly, there will be smooth brake operation. Vibrations and pulsations result when the friction transfer layer becomes uneven for a variety of reasons.

Symptoms can range from a steering wheel judder to a pedal pulsation. Pedal pulsations are the result of a disc thickness variation (DTV), while brake induced steering wheel judder is generally a result of a torque variation. Both of these are due to an uneven rotor surface condition.

There are three primary reasons for the rotor surface to become uneven:

1: Brake rotor Total Indicated Runout (TIR).

TIR, or Runout, is the side to side wobble of the rotor as it spins. Most OEM service information provides a specification for maximum installed rotor runout, which is to me measured while the rotor is installed on the hub. It is critical to measure runout and confirm compliance with the OEM specification any time a new rotor is installed or a machined rotor reinstalled on the hub. The most common cause of excessive runout is poor hub condition/failure to properly clean rust from hub before installation. Improperly machining a brake rotor can result in excessive runout as well.

Excessive runout on its own will rarely result in any immediate symptoms, but over time, as the high spots on either side of the rotor contact the pads more often and at higher pressures than the rest of the rotor surface, a different effect will be had on the transfer layer at those two spots…resulting in first a torque variation, and then progressing to a thickness variation.

http://www.centricparts.com/files/technical%20guides/brake-rotor-installation-tips.pdf

2: Corrosion. More common in areas where road de-icing chemicals are used, but not unheard of in other environments as well, especially where vehicles are not used on a regular basis, corrosion can

attack the brake rotor friction surface, degrading the friction transfer layer. Corrosion, in many cases will not occur to the same extent on the exposed portions of the rotor and the portion shielded by the brake pads when the vehicle is parked….resulting in somewhat degraded friction transfer layer on the majority of the rotor surface and a fairly protected transfer layer on the portion that was covered by the brake pads. The "sticky" spot on the rotor will create a greater level of friction every time it passes through the pads, causing the steering wheel to vibrate back and forth while applying the brakes. Minor cases, before surface damage has occurred to the rotor, will generally solve themselves by simply driving the vehicle….the pads will clean up the rotor surfaces. In more severe cases, the problem will continue to get worse as the vehicle is driven. Pitting will usually be visually evident on the rotor surface, along with evidence of where the edges of the brake pad contacted the rotor while the vehicle was sitting. Image #1 shows a fairly severe case of this, while image #2 shows a fairly minor, but still annoying case of this.

The only solutions in this case are to replace or machine the rotors, along with measures to prevent the occurrence of corrosion (drive the car more often, store in a garage, etc…). A more abrasive brake pad will also aid in keeping the rotor surface clean in particularly corrosive conditions.

Image 1:

Image 2:

3: Excessive/uncontrolled friction transfer due to overheating or improper pad selection

More common in the performance world, but still occurs from time to time under normal driving conditions, most often with substandard brake pads.

http://www.centricparts.com/files/White%20Paper%20Revisions%204-2012/Centric%20White%20Paper%20B1-2012-Warped%20Brake%20Disc.pdf

Not every vehicle will benefit from “Upgraded” or “High Performance” brake pads. If the vehicle is most often driven in a normal manner encountering no real high heat situations, then a more standard type street pad is going to be the best option. Every brake pad has an optimal heat range in which it will perform best. It makes no sense to use a friction formula that operates best over 800° when the vehicle will rarely see brake temperatures over 400°. The higher heat range pad will not perform as intended at lower temperatures…and along with noise and reduced performance, usually have a problem maintaining an even and sufficient friction transfer layer, which can sometimes result in a pulsation concern.

On the other hand, if the vehicle is constantly exposed to very high brake temps, a “normal” street pad will overheat, resulting in excessive wear and uneven friction transfer. Centric Parts offers a wide range of friction formulations to suit every driving style.