

Commentary

Beyond Birth Control: Hormonal Contraceptives May Provide Protection from Knee Ligament Injury Requiring Surgery

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Abstract

Women who take birth control have a protective benefit of a lesser risk of anterior cruciate ligament injury. This protective effect occurs with all forms of hormonal birth control regardless of the combination of medications or if the method is oral, a device, or systemic. Attempts to establish a specific cause to this benefit have centered on mechanical strength studies of ligaments, flexibility and muscular strength. These studies have failed to appreciate the complexity and interactions of hormones in the complex physiology that includes cognitive performance, postural stability, and brain function that includes risk avoidance. Although there are proven benefits of hormonal birth control on decreasing the risk of knee surgery, the causative reasons are not simple to define.

It has been established that females are at higher risk of anterior cruciate ligament injury than their male counterparts [1-3]. Numerous studies have been performed to determine the reason for this. Among possible causes for this disparity are the changes in hormones that occur during the female ovulatory cycle. It has been found that there is a definite increased risk of ligament injury with hormonal fluctuation [4,5].

This knowledge was the basis of a recent detailed study by Fry, Hirpara, Whitney, Keeter, Constantine, Williams, and Drago. Using a computer database from the Colorado Health Data Compass system, 14,886,766 females were evaluated for having had an ACL injury requiring surgery. Of this group the 2,120,628 females taking hormonal contraceptives had a lower ACL surgical incidence than the 12,766, 38 females who did not take any contraceptive. This lower risk was present irrespective of the type of hormonal birth control used, (oral, IUD, implant), or the formulation of the method used. When stratified by age, only the 15-19 year age group showed no difference in risk of needing ACL surgery. It was concluded that hormonal contraceptive use is associated with a lower incidence of ACL injury requiring surgery [6].

Within the orthopedic community there have been many studies directed at finding out the reason to explain this protective mechanism. As orthopedics is a field predominantly directed at the treatment of musculoskeletal issues, attention has been directed at the effects of hormones on musculoskeletal strength, flexibility and effects on loads causing ligament failure. However, this prior research gives no definitive answer and there is no proven cause and effect regarding hormonal effect on ligament strength, flexibility, and anterior cruciate ligament failure [7,8].

It has been established through prior research that the female sex hormones, (estrogen, progesterone and relaxin), rise and fall dramatically during the normal menstrual cycle. These changes have been associated with findings of increased ligamentous laxity and a decrease in neuromuscular performance. Because of these changes, it has been theorized that this results in a decrease in passive knee stability and resultant greater chances of injury [9]. Unfortunately, it is simplistic to assume that hormonal effects on the need for ACL surgery are solely due to the biomechanics of ligament strength or muscular strength.

If one looks beyond the biomechanical studies, there are studies which give additional insight regarding how hormonal fluctuations change athletic performance. Consider the study by Lee et. al. An evaluation of balance during the menstrual cycle, postural sway was significantly higher 13 days after the onset of menstruation. Their change was sufficient to effect static balance and could potentially increase risks of injury. Specific exercises were recommended in order to prevent injury during this hormonal phase [10].

Additional balance changes were noted by Friden. His study revealed that during a one-legged stance with eyes wide open, there was a significant increase in postural displacement during the mid-luteal phase. Such changes were associated with postural instability and a reported increase in injury rate [11].

Recent studies have evaluated the effect of sex hormones on both cognitive performance and brain function that are involved directly in movement control. There is a direct impact on behavioral consequences and neuropsychological processing [12]. This will result in how a person reacts and responds to challenging situations in a sports environment.

Reviewing the influence of sex hormones on non-biomechanical properties, Souza et. al. found an influence on visuospatial and motor skills, attention and concentration, verbal memory, visual memory, working memory, and reaction time. When evaluating performance scores, there was a tendency towards a worse performance in the luteal phase [13]. Reaction time was changed which may result in an increased risk of injury and subsequent need for ligament surgery.

Included in the non-biomechanical effects of hormones are the direct effect of hormonal associated changes on brain function and risk aversion. It is found that risk aversion is greater in women than men. Women are less risk tolerant than men. This is thought to be a reason why there is a lower return to sport after ACL reconstruction in females when compared to males of equal post-operative function [14]. There is a more favorable response to a physical stressor during the late follicular to ovulatory period of the menstrual cycle. This results in changes to the risk taking behavior [15,16]. Hormonal birth control affects the cycle and associated brain function that controls risk aversion.

Returning to the study by Frye et. al., it was reported that the use of hormonal contraceptive is associated with a lower incidence of ACL injury requiring reconstruction when compared to no contraceptive use [6]. From the data, it is clear that there is a benefit regarding the use of contraceptives in decreasing the chance of an injury resulting in surgery. However, the causation is multifactorial. One must not assume that the direct effects of hormones on ligament or muscular biomechanics is the causative reason for these findings.

There is a paradox in the study by Frye, et.al. The protective benefits of hormones on ligament injury needing surgery was not as apparent in the 15-19 year age group. This data was in direct contradiction to work by DeFroda who reported a protective benefit in this age group [17]. Frye et al. explains this problem of no protective benefit from hormonal contraceptive as being secondary to possible hormonal irregularity that may occur in this age group.

A detailed review of the methodology used by Frye et. al. finds that the data collection for this age group was flawed and may explain the results. As previously described, the study was performed using an insurance database to confirm the use of oral contraceptive pills, (OCP). It was assumed that all OCPs are given by prescription and would appear as an insurance claim. For this age group, 15-19, this is an inherently poor way to determine OCP usage.

Frye, et. al. states females in this age group, 15-19, had a reported use of OCPs at 13.6% [6]. However, use of OCPs in this age group has been reported to be as high as 80% [18].

The error in utilization occurs because an insurance database is an inherently flawed way to determine usage of OCPs in 15-19 year olds. Surreptitious use of OCPs by teenagers, without the usage of parental insurance, is an established fact. Multiple organizations provide OCPs to teenagers irrespective of parental knowledge or insurance [19]. As such, the use of OCPs as measured by insurance database information is grossly underreported with secondary data distortion.

What is apparent is that the use of hormonal birth control, regardless of the method used, can and does have an association with a

decreased incidence of ligament injury resulting in surgery. The reason for this is unclear. It may be secondary to biomechanical ligament strength, postural adaptiveness, cognitive awareness, risk aversion, visual spatial interpretation or a multitude of other physiological changes that occur under hormonal fluctuations.

Whether there is a specific singular cause or if it is secondary to dozens of neuromuscular, physiologic and neurologic effects, the end result has a small protective benefit to the knee. This information provides the female athlete with added options when considering methods of decreasing the risks of ligament injury needing surgery.

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