The Effect of Phase of Menstrual Cycle on Joint Mobility in the Cervical Spine and Extremities in Nulliparous Women: A Cross-Sectional Study

Carol Ann Weis, MSc, DC, Diane Grondin, MHK, DC, and Howard Vernon, DC, PhD

Abstract

Objective: The purpose of this study was to investigate the range of motion (ROM) of various joints in women throughout the menstrual cycle to determine whether there would be a difference in the ROM between the luteal and follicular phases during extension at the fifth metacarpophalangeal joint and bilateral rotation of the cervical spine in young adult nulliparous women.

Methods: Sixteen nulliparous women of childbearing age (mean age, 26 years) were recruited from the academic institution where the study was being performed. Participants were randomized into and tested during either the luteal or follicular phases of the menstrual cycle. In the following month, participants were tested in the opposite phases of the menstrual cycle. All testing was performed by a doctor of chiropractic. Differences in ROM were measured in single joint movements (fifth digit hyperextension) and in multijoint movements (bilateral cervical rotation) using an electromagnetic sensor system.

Results: No significant effects of phase were found on peak ROM of the fifth digit or during cervical spine rotation (left, right, or bilaterally), irrespective of trial.

Conclusion: There is no difference in ROM of the cervical spine or the fifth metacarpophalangeal joint, regardless of the phase of menses, suggesting there is likely no hormonal influence on these structures during the follicular or luteal phases. (J Manipulative Physiol Ther 2016;39:393-400)

Key indexing terms: *Safety; Joint Instability; Menstrual Cycle; Spine; Cervical Vertebrae; Upper Extremity*

Introduction

Joint hypermobility is a condition in which a synovial joint can move beyond the normal physiological limits, but not beyond the normal anatomical limits.[1] Another term commonly used is *joint laxity*. There is a wide range of what is considered normal motion in most joints.[1,2] This normal motion often varies with age, race, body build,[3] and gender.[2,4,5] Hypermobility can be inherited or acquired through years of training and stretching as seen in ballet dancers and gymnasts.[1] Symptoms frequently start in childhood, and if they do so by age 15, they will continue into adult life for three-quarters of those who experience them.[1]

It is widely accepted that women are more susceptible to increases in joint laxity than men.[2,4,5] One cause for this increase in joint laxity in women has been postulated to be hormonal in nature.[6–8] Relaxin, a polypeptide that is produced by the corpus luteum during pregnancy,[9] is one such hormone. During pregnancy, relaxin is detected from the time of the first missed menses and peaks around 12 weeks of gestation.[10] It then decreases in the second trimester and remains stable until labor and delivery.[10] In the pregnant woman, relaxin has been shown to be essential for securing the passage of the fetus during parturition in several animal species.[11] It has also been associated with a decrease in soft tissue stiffness, especially in preparing the female body for pregnancy, including relaxing the pelvic ligaments, inhibiting spontaneous uterine contractions, ripening of the uterine cervix, and stimulating the mammary glands.[12] Although relaxin increases laxity in the symphysis pubis in preparation for birth, its effects are not limited to just this joint.[13]

Pregnancy is not the only time of considerable hormonal fluctuation in women. In the nonpregnant state, menses can also be considered a cycle of physiological change unique to the female endocrine system. Changes in the circadian blood serum sex hormone levels can include progesterone,

Graduate Education and Research Program, Canadian Memorial Chiropractic College, Toronto, Canada.

Submit requests for reprints to: Carol Ann Weis, MSc, DC, 6100 Leslie St, Toronto, ON M2H 3J1. (e-mail: *cweis@cmcc.ca*).

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estrogen, relaxin, and testosterone.[14] In women who are not pregnant, there are 3 phases to the menstrual cycle: the follicular (or proliferative) phase, which occurs on days 1 to 9, the ovulatory phase, which occurs on days 10 to 14; and the luteal (or secretory) phase, which begins on day 15 and lasts until the end of the cycle. Each phase is associated with the hormone relaxin, which is secreted by the ovaries during the luteal phase of the menstrual cycle,[9] reaching its peak around day 14. Although progesterone and estrogen levels have been the focus of much research, levels of other hormones, such as relaxin, may also play a role in ligament behavior.[14] Furthermore, the implications may be even greater with repeated activity; due to the viscoelastic nature of biological tissues, there is a decrease in stiffness with repeated stretching.[15]

Female athletes have been shown to have a 4- to 6-fold increased risk of anterior cruciate ligament (ACL) injury compared with their male counterparts.[14] Although no definite etiology for these discrepancies has been determined, structural, neuromuscular, and hormonal factors have been proposed.[14] Although a recent systematic review reported that 6 of the 9 studies did not demonstrate a significant effect of the menstrual cycle on anterior knee laxity in women, this lack of positive evidence does not preclude the potential effects of sex hormones on ligament laxity.[14] The remaining 3 studies in this review reported increased laxity during the ovulatory and luteal (postovulatory) phases of the menstrual cycle compared with the follicular (preovulatory) phase. This finding led the investigators to suggest that a difference may exist between the pre- and postovulatory phases. In addition, a meta-analysis performed on the same 9 studies reported that laxity increased during the ovulatory and luteal phases of menses; knee laxity measured at 10 to 14 days was greater than at 15 to 28 days, which was greater than at 1 to 9 days.[14] At the conclusion of their systematic review, Zazulak et al suggested that the menstrual cycle may have an effect on anterior-posterior laxity of the knee and that appropriate protocols to control for confounding variables would be required to investigate this hypothesis completely.[14]

Generally, a person with increased range of motion (ROM) would have little cause for concern; however, some individuals may be predisposed to a wide variety of soft tissue injuries and internal joint derangements, arthritis, arthralgias, or myalgias.[1] Furthermore, if the hormone relaxin causes excessive ROM or ligament laxity in pregnancy, it could potentially cause a similar finding in the nonpregnant woman. Given the unique nature of the menstrual cycle and fluctuating hormonal levels, ligament laxity could result in an injury to a female individual, as documented in the ACL. The suggestion that fluctuating hormone levels affect the ACL also raises the question of whether this effect would exist in other areas of the body, including motions involving a single joint (such as that of the fifth finger metacarpophalangeal joint [MPJ] or those involving multiple joints, such as the cervical spine), given the systemic nature of the hormonal changes.

Increased risk of injury in the area of the cervical spine has been postulated to be associated with cervical manipulation; however, the incidence of this risk and the mechanisms underlying it are poorly understood.[16–18] Whereas greatest attention has been focused on the vertebral artery[19–21] and its potential for injury during rotational activity,[20] including but not limited to manipulation, less attention has been paid to the joints of the upper cervical spine themselves. Their intrinsic stability maintains normal limits of joint excursion thereby limiting the tensile load on the supporting soft tissues and, indirectly, limiting loads on the vertebral artery. If the ROM of the joints is increased, one can logically surmise that the soft tissues may be at risk for increased stress. Although certain pathological conditions that compromise the stability of the upper cervical joints are well known (ie, rheumatoid arthritis, congenital anomalies), what is not known is whether there are "normal" variations in joint ROM experienced by women during their menstrual cycle, nor whether these variations could result in compromise of the upper cervical soft tissues.

Knowing the effects of hormonal fluctuations has the potential to transform the management of musculoskeletal conditions in general. The effects in the cervical spine may be considered when determining whether an individual is a candidate for upper cervical manipulation during course of care, but it may also be considered when deciding on the appropriateness of treatment for any joint, series of joints, or surrounding soft tissues. Therefore, the purpose of this study was to investigate the ROM of various joints in women throughout the menstrual cycle to determine whether there would be a difference in the ROM between the luteal and follicular phases during extension at the fifth metacarpophalangeal joint and bilateral rotation of the cervical spine in young adult nulliparous women.

Methods

Participants

Subjects were recruited through word of mouth, mass e-mail, and posters at the academic institution involved in the study. Sixteen women were recruited from the campus and clinics of the institution involved on a first-come, first-served basis. These included students, interns, faculty, and patients. To be accepted into the study potential subjects had to be nulliparous women of childbearing age (20-40 years old) who were experiencing regular menstrual cycles (28 ± 4 days).[22] Subjects were unable to participate if they were currently pregnant, experiencing or had early onset of menopause, had received any type of manipulation (high velocity low amplitude thrust) in the cervical spine,