Sex In Your Practice:

Examining Sexual Dimorphism in Posterior Tibial Tendon Dysfunction, Hallux Valgus, Patellofemoral Disorders, and Spinal Conditions

Elizabeth Arendt, MD
University of Minnesota
Minneapolis, MN
WHIAB Chair

Laura Gehrig, MD
Medcenter One
Bismarck, ND
WHIAB Member
Disclosure: Unpaid consultant for InMotion Musculoskeletal Institute.

Julie Switzer, MD
Regions Hospital
Saint Paul, MN
WHIAB Member
Disclosures: Research or institutional support from Biomet; Smith & Nephew; Stryker; Synthes; Zimmer.

Ruth Thomas, MD
University of Arkansas
Little Rock, AR


AAOS
American Academy of Orthopaedic Surgeons
Women’s Health Issues Advisory Board

www.aaos.org/women
Dimorphism and Posterior Tibial Tendon Dysfunction

Preliminary Findings of the Etiology of Sexual Dimorphism in the Literature

Background
PTTD affects more women than men: specifically over-weight (obese) women around the age of 55. While this correlation has been noted, little information is available specifically identifying risk factors that contribute to this development and difference between men and women. Since there are indeed sex based differences in cell biology, tissue function and disease presentation, this preliminary review sought to determine if major variables or predominant characteristics regarding sexual dimorphism could be identified in patient population with PTTD as presented in the literature.1

Methods
A general systemic review of the literature Medline/PubMed including orthopaedic journals to identify certain consensus criteria with regard to PTTD and the prevalence in men and women was conducted.

Use of keywords and medical subject headings were: Posterior Tibial Tendon Dysfunction; Posterior Tibial Tendon Dysfunction and Sexual Dimorphism. A preliminary review of 12 articles from 110 found were selected. These papers reported on management of patient populations with either non-operative or operative intervention for PTTD.

Data and observed co-morbidities analyzed from these papers included: sex, age, height, weight, BMI, gonadal history (menopausal status if female), medical diseases (Diabetes, HTN, connective tissue diseases), steroid injection, trauma. Only one article was found when a literature search using “PTTD and sexual dimorphism” was conducted.

Results
Of the selected 12 articles analyzed only 2 articles had detailed information on patient characteristics. One article broke these down with respect to sex. In 11 articles reviewed, the total number of female patients was 310 (80%). The total number of male patients was 75 (20%). A traumatic event or steroid injection was found to be mentioned in 4 papers. Only 3 of 11 papers recorded co-morbidities such as HTN, obesity or DM. Only one article regarding sexual dimorphism is found in the literature. This article was published in a Physical Therapy Journal and assessed kinematics of gait, with a control population of equal males and females without any recorded co-morbidities. No article in the orthopaedic literature identified specific sexual dimorphism characteristics associated with PTTD. Eleven of 12 articles listed a predominant female population.

Conclusions
Eleven out of twelve articles published and analyzed from a literature search had a larger percentage of women with PTTD but did not report on sexual dimorphism or co-morbidities related to sex. No explanation was given to explain this prevalence. Correlation between sexual risk factors and co-morbidity issues to each sex is lacking. Further research is needed to determine if sexual physiology/metabolism and genetic may play a part in the PTTD found predominately in females. Review and correlation of PTTD and patient population characteristics at our Institution is pending based on IRB approval.

Reference Cited:

For a complete list of references, please contact Laura Gehrig, MD, at laura.gehrig@gmail.com.
Hallux valgus is the most common pathologic entity affecting the great toe. This deformity affects 2% to 4% of the population and it clearly occurs more frequently in females than in males.9,19 Early studies have documented that hallux valgus deformity is present in at least twice as many females as males even in adolescence.13,27 In multiple series reporting surgical correction of juvenile hallux valgus deformity the incidence of females ranges from 84% to 100%.2,12,18,24,25,26 This preponderance of females with bunion deformities increases significantly in adults.5 Women seeking surgical intervention for their bunions outpace men by a ratio of approximately 9 to 1 with multiple studies reporting female patient ratios exceeding 90%.5,11

The primary intrinsic factor in the development of hallux valgus deformity cited by most authors is genetic predisposition.2,3,7,18,21 In 1951 Hardy and Clapman reported that 77% of patients reported that their mothers also had bunion deformities.11 Coughlin reviewed 60 feet with juvenile hallux valgus and noted maternal transmission of the disorder in 72% of cases with variable penetrance of the trait.3 In his 2007 article he found that 84% of his surgical patients with hallux valgus deformity had a positive family history and 27% of these reported a 3 generation history of the deformity.5 Adolescents also develop hallux valgus deformity. In the historical studies by Hardy and Clapman11 and later by Piggott20 50% of adult patients with hallux valgus deformity reported that their deformity began in adolescence. Coughlin reported that the deformity developed before the age of 10 in 40% of his patients with juvenile hallux valgus deformity.5 The feet of adolescents have not been exposed to shoes with narrow toeboxes and therefore this extrinsic factor cannot be blamed for the hallux valgus deformity. Men also develop hallux valgus deformity and men's shoes typically do not have narrow toeboxes.4,7 The incidence of juvenile and adolescent hallux valgus deformity, the fact that men also get these deformities and the fact that 84% of patients with hallux valgus have bilateral deformities further supports a genetic etiology.5

In summary, hallux valgus deformity occurs much more frequently in women than in men. Although the constriction of women's shoe wear has been implicated as a major causative factor in the development of hallux valgus in women, there is clearly strong evidence for maternal genetic transmission of the deformity. It seems clear that because of genetics some women will develop hallux valgus deformity no matter what type of footwear they choose. However, there is likely a subset of women who have a genetic propensity for hallux valgus deformity that do not develop the deformity until they have subjected their feet to narrow constrictive shoe wear for many years.

References:
Dimorphism and Patellofemoral Disorders

Patellofemoral Pain
A longitudinal study of 63 girls with patellofemoral (PF) pain, identified initially in 1974 (average age: 15.5 yrs), found that 50% improved during the first 4 years, and an additional 23% improved in the subsequent 12 years. Within the subgroup that continued to have PF pain, none demonstrated significant structural disease. Several statistical analyses of various physical exam measurements, including radiographs, were performed. In this young age group, the researchers could not identify any factor that predicted who would fail (have continued pain) and who would improve. ¹

To identify factors that might contribute to anterior knee pain, another group of investigators looked at physical exam features including sex, age, body composition, athletic activities, and duration of symptoms. They found only one significant predictive factor: the younger the patient, the more favorable the outcome. Sex was not a predictive factor. ²

De Haven and Litter reported on patients with knee disorders over a 7 year period. They reported that 18% of knee disorders in males and 33% in females were associated with PF pain.³ A prospective study following students in an athletic population for two years found that a shortened quadriceps muscle and a hyper mobile patella were risk factors for PF pain. The development of pain was not statistically different between boys and girls. ⁴

Central to the discussion of PF pain is an understanding of whether pain is perceived qualitatively differently by females. Females are more sensitive to pain stimuli, less tolerant of pain and more able to discriminate between different pain pathways. ⁵

Patellar Instability: Lateral Patellofemoral Dislocations
Patellar instability is largely felt to be a problem more common in females, yet most of the published literature on acute patella dislocations has a predominance of males in the study populations. The most likely reasons is that the period of study is from a time when most athletes were male.

One population based study found an equal number of males and females who sustained first time patella dislocations.⁶ A systematic review of first time traumatic patellar dislocations found the following ratio: 46% male and 54% female.⁷ However, many studies are in agreement that females have an increase in recurrent patella dislocations.

The 10-17 year age group is most at risk for recurrent patella dislocations. Risk factors associated with recurrent instability include female sex, age less than 15, particularly less than 13, with open physes. This increased risk of recurrent instability is likely due to an increase in distal femoral dysplasia in females.

Trochlear dysplasia has long been recognized as a factor in patellofemoral instability.⁸ Although we do not have good demographics on the percentage of females with distal femoral dysplasia, we do know that trochlear dysplasia and patella alta are more common in women.⁹

Patellofemoral Arthritis
Mc Alindon et al. (1992) reported patellofemoral arthritis twice as often in females than males.⁹ A large multi-center study done by French orthopaedists supports a greater incidence of isolated patellofemoral arthritis in females. Of 578 patients reviewed, 72% were female. Within their subgroup, 33% had radiographic evidence of one or more dysplastic features of the distal femur which they believe are predictive of isolated patellofemoral arthritis.¹⁰

Conclusion
Population demographics defining PF disorders by sex are scant. Clinical data, however, support the fact that PF recurrent dislocations and isolated patellofemoral arthritis are more common in females. Potential risk factors likely include anatomic and neuromuscular factors. Patellofemoral dysplasia is highly correlated with PF arthritis and PF lateral dislocations.

References
Sexual Dimorphism in the Spine and Spine Conditions: An Overview

The purpose of this abstract is to determine sexual dimorphism, if any, in spine morphology and spine conditions. A literature search was conducted and information regarding the most up-to-date information on sexual dimorphism in the spine will be reported.

Spinal Development

Differences in anatomy based on embryology and maturation. With regard to spine development in general, prenatally, ossification timing is noted to be significantly earlier in girls than boys. Thecal sac termination shows no differences, but the conus medullaris ends slightly lower in women than men. As development occurs and the bones of the spine develop, height changes occur in girls earlier than in boys. Girls have a growth spurt at 8.5 years, boys at 13.5 years. The result after formation of the vertebral bodies, and the relationship of height to transverse diameters is a slightly shorter more slender female vertebral column. This more slender vertebral column is postulated to be more prone to deforming forces which may contribute to increased risk of scoliosis.

Adolescent Scoliosis: Sexual Dimorphism Manifestation

The female to male ratio for curves greater than 10 degrees is nearly equal, however for curves greater than 30 degrees, there is a female predominance of 10:1. Curve patterns: left curves are more common in boys, girls who are premenarchal have a higher incidence of left curves than older girls. Curve progression is affected by a higher proportion of vertebral height to transverse diameter in girls and more likely to progress. Also, if the curve in girls is greater than 30 degrees, it is more likely to progress. In boys, progression may be related more to immature Risser status but not age or curve magnitude. With regard to surgical intervention, curve magnitudes are typically greater in boys. Male patients also have longer operating time, greater blood loss and less primary curve coronal plane correction.

Degenerative Disorders: Differences Between Men and Women

With aging, females demonstrate greater motion in all spinal planes regardless of the severity of degenerative changes of the spine. With male specimens, significance was observed in all motion planes in males with progression of degenerative changes, but only axial rotation was significantly affected in females with degenerative changes.

Qualitative Bone Mineral Density

Bone mass in young adult men is greater than in women, depending more on bone size rather than density. This affects bone loss with aging, as elderly men are possess greater bone size and bone mineral content in general. It appears that osteoporosis in women may be due more to poor mineral deposition in elderly women, as both sexes demonstrate similar rates of bone resorption. Male predominance is observed in degenerative disorders involving structural anatomy such as isthmic spondylolisthesis, spinal stenosis in the cervical and lumbar spine, disc degeneration and ankylosing spondylitis.

Spondylolysis was also found to be higher in males by a ratio of 3:1, (Female predominance is observed in conditions that involve stability due to laxity such as degenerative spondylolisthesis, rheumatoid arthritis with resulting atlantoaxial instability. Theories for degenerative spondylolisthesis propose that sex difference is due to expression of sex hormones, as well as postural differences such as lumbar lordosis, sacral inclination, pelvic incidence, etc also contribute to the sexual dimorphism.

Fragility Fractures

With age related bone loss over time, both men and women sustain spine fractures. However, they occur less commonly in men than women. The explanation for this difference is proposed to involve reduced periosteal bone formation. The resultant skeleton is established by changes during growth and then aging by the activity on the periosteal surface and also on the endosteal surface relative to the periosteal surface. More absolute periosteal bone formation is achieved in men. Net bone loss is less in men than women. Together the resultant mass and architecture establish the skeleton’s strength to withstand forces in old age. This then contributes to reduced bone in women, which contributes to the pathogenesis of increased spine fractures in women with age.

References

4. Sexual Dimorphism in vertebral Fragility is More the result of gender Differences in Age-related Bone Gain than Bone Loss. Duan, Yunbo; Turner, Charles H.; Kim, Bom-Taek; and Seeman, Ego. Journal of Bone and Mineral research 2001; Volume 16, Number 12: 2267-2275