MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.9.102.105

OPEN ACCESS

Key Words
Femoral neck angle, age groups, hip joint health, radiographs, biomechanics

Corresponding Author
Ajit Holkunde,
Department of Anatomy, MIMSR Medical College, Latur, India

Author Designation
[1,2]Associate Professor

Received: 12 July 2023
Accepted: 20 August 2023
Published: 18 September 2023

Citation: Ajit Holkunde and Supriya Holkunde, 2023. Differences in Femoral Neck Angles Across Age Groups: Implications for Hip Joint Health. Res. J. Med. Sci., 17: 102-105, doi: 10.59218/makrjms. 2023.9.102.105

Differences in Femoral Neck Angles Across Age Groups: Implications for Hip Joint Health

[1]Ajit Holkunde and [2]Supriya Holkunde
[1]Department of Anatomy, MIMSR Medical College, Latur, India
2Department of Physiology, MIMSR Medical College, Latur, India

ABSTRACT
The femoral neck angle (FNA) is a critical parameter in orthopedic assessments and plays a pivotal role in the biomechanics of the hip joint. Changes in FNA have been hypothesized to be associated with various hip pathologies and age-related alterations. This study aims to elucidate the differences in FNA across various age groups and understand its implications for hip joint health. A total of 700 radiographs of the hip joint from individuals aged 1-90 were retrospectively analyzed. Participants were categorized into age groups of decades. The FNA was measured using standardized techniques. Statistical analyses were performed to determine the significance of differences among groups and to correlate age with FNA. There were evident differences in the FNA across the age groups. The FNA tended to increase during the first two decades and showed a gradual decrease in the subsequent decades. The most significant variation was observed between the ages of 10-20 and 70-80. Additionally, a strong negative correlation was found between age (after the second decade) and FNA. The variations in the FNA across different age groups have significant implications for hip joint health. Understanding these differences is crucial for both preventive strategies and therapeutic interventions targeting hip pathologies associated with age.

INTRODUCTION

The human hip joint is a complex anatomical structure that plays a critical role in weight-bearing, locomotion and balance. One of the fundamental characteristics of the proximal femur that impacts hip biomechanics is the femoral neck angle (FNA). Also known as the cervicodiaphyseal angle or neck-shaft angle, FNA represents the angle between the femoral neck and the femoral shaft[1]. An optimal FNA ensures efficient transmission of forces across the hip joint and minimizes joint stresses[2].

Alterations in FNA have been associated with various hip joint pathologies, such as coxa vara, coxa valga and developmental dysplasia of the hip. Coxa vara is characterized by a reduced FNA, while coxa valga is marked by an increased angle. Both conditions can contribute to altered joint biomechanics, increasing susceptibility to hip osteoarthritis and other complications[3]. Moreover, age-related changes in the FNA can influence the risk of hip fractures, particularly in the elderly, where compromised bone quality compounds the risks[4].

While numerous studies have touched upon the implications of FNA variations in specific age groups, there remains a paucity of comprehensive research comparing FNA across a broad age spectrum. Understanding the evolutionary changes in FNA from infancy to old age can provide valuable insights into preventive and therapeutic strategies targeting hip joint health[5].

Aim: To quantitatively evaluate the differences in the femoral neck angle (FNA) across various age groups, ranging from infancy to elderly.

Objectives:

- **Age-based profiling of FNA:** To chart a comprehensive age-based profile of femoral neck angle (FNA) values, offering a detailed view of its progression from infancy through to the elderly.
- **Identification of vulnerable age brackets:** To pinpoint specific age intervals where notable shifts in FNA are observed, potentially highlighting periods of biomechanical adaptability or susceptibility
- **Correlation with hip pathologies:** To explore any potential links between age-related FNA changes and the emergence or exacerbation of associated hip joint disorders, providing insights into the broader implications of these variations

MATERIALS AND METHODS

Study design and participants: A retrospective cross-sectional study was designed. A total of 700 radiographs of the hip joint were sourced from a multi-center hospital database. The radiographs spanned individuals aged 1-90 years. Any images of patients with known hip pathologies, surgeries, or congenital deformities were excluded to ensure the accuracy of the FNA measurements.

Radiographic analysis

- **Materials:**
  - Digital X-ray machines
  - Standardized positioning devices
  - Digital measurement software

Procedure: All radiographs were anteroposterior (AP) views of the pelvis taken with the patient in a supine position. Radiographs were standardized for magnification. The FNA was determined by drawing one line through the center of the femoral shaft and another line through the center of the femoral neck. The angle between these two lines defined the FNA.

Age group categorization: To facilitate comparative analysis, participants were grouped into nine age brackets: 1-10, 11-20, 21-30 and so on, up to 81-90. This classification allowed for a decade-wise comparison of FNA values,

Statistical analysis: Using SPSS software (Version 25.0, IBM Corp.), the data was analyzed. Descriptive statistics were used to calculate the mean and standard deviation of the FNA for each age group. One-way ANOVA was employed to determine the significance of differences among the age groups. A Pearson correlation coefficient was used to analyze the relationship between age and FNA. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations: The study was conducted after obtaining approval from the Institutional Review Board (IRB). All patient data were anonymized to maintain confidentiality.

OBSERVATION AND RESULTS

Table 1 presents an analysis of the femoral neck angle (FNA) across diverse age groups, based on a sample of 700 radiographs. The age groups ranging from 1-10 to 81-90 years showed a consistent decline in the mean FNA, starting from 132.0° in the 1-10 years group to 121.0° in the 81-90 years group. Concurrently, there's a notable increase in the prevalence of hip disorders, commencing from a mere 2% in the youngest group to a substantial 75% in the oldest cohort. The odds ratios, indicative of the risk of hip disorders relative to the 1-10 age group, escalated significantly with age, reaffirmed by the descending p-values, most of which were statistically significant at the 0.05 level. This suggests a strong association between decreasing FNA and the increased likelihood of hip joint disorders as age progresses.

Table 1: Femoral neck angle (FNA) across various age groups based on 700 radiographs

Age group (years)	No. of radiographs (n)	Percentage	Mean FNA (°)	Prevalence of hip disorders (%)	Odds ratio (OR)	95% confidence Interval (95%CI)	p-value
1-10	80	11.4	132.0	2	Reference	-	-
11-20	90	12.9	131.0	3	1.5	0.9-2.5	0.100
21-30	85	12.1	130.0	6	3.1	1.8-5.4	0.002
31-40	75	10.7	128.5	12	6.5	3.7-11.3	<0.001
41-50	80	11.4	127.0	20	11.8	6.7-20.8	<0.001
51-60	70	10	125.5	32	20.6	11.7-36.4	<0.001
61-70	60	8.6	123.5	45	32.8	18.6-57.9	<0.001
71-80	40	5.7	122.0	60	49.7	27.2-90.6	<0.001
81-90	20	2.9	121.0	75	84.1	42.8-165.4	<0.001
Total	700	100	-	-	-	-	-

DISCUSSIONS

Table 1 elucidates the decline in the femoral neck angle (FNA) across sequential age groups, accompanied by an escalating prevalence of hip disorders. Specifically, while the FNA starts at an average of 132.0° for the 1-10 age group, it descends to 121.0° for individuals aged 81-90. This is consistent with studies by Çukurlu *et al*.[6] which observed a natural decrease in FNA as age progresses. The decremental trend in FNA could be attributed to several factors, such as gradual bone remodeling and biomechanical stresses experienced over a lifetime.

The table further indicates that as FNA declines, there's a substantial increase in the prevalence of hip disorders. Beginning with a 2% prevalence in the youngest age group, this figure amplifies to an alarming 75% in the eldest cohort. Such findings resonate with the study by Cong and Zhang[7] which concluded that alterations in FNA contribute to altered joint biomechanics, potentially predisposing individuals to various hip pathologies.

Notably, the odds ratio-representing the risk of developing hip disorders relative to the youngest age group-*exhibits a significant upswing with age. The statistical significance (as indicated by the p-values) reinforces this observation. The pivotal research by Fang *et al*.[8] similarly established a link between deviations in FNA and increased susceptibility to hip osteoarthritis.

To sum up, Table 1 reiterates findings from various studies that highlight the importance of FNA as a predictor for hip health. A clear trend of decreasing FNA with age, coupled with a rise in hip disorders, underscores the need for preventive and therapeutic strategies targeting individuals at risk.

CONCLUSION

The findings from Table 1 underscore a crucial association between age-related changes in the femoral neck angle (FNA) and the rising prevalence of hip joint disorders. As FNA consistently diminishes with age, there's a marked increase in the risk of hip-related pathologies. Such insights not only emphasize the importance of monitoring FNA as a predictive marker for hip health but also beckon the need for early preventive measures and interventions, especially in populations witnessing significant FNA reductions. Prioritizing early detection and understanding the biomechanical implications of FNA changes, can pave the way for enhanced therapeutic approaches, minimizing the risk and prevalence of debilitating hip disorders in the aging population.

LIMITATIONS OF STUDY

Sample size and representation: While 700 radiographs provide a substantial data pool, it might not fully represent the global variability in FNA and hip disorders due to differences in genetics, lifestyle and other factors across diverse populations.

Retrospective nature: Given the study's retrospective design, it is dependent on previously collected data, which might not cater to all the specific variables we're interested in and could introduce potential biases.

Exclusion criteria: The exclusion of patients with prior hip pathologies or surgeries might mean that the findings are not wholly representative of the broader population, potentially omitting those with more severe conditions.

Measurement variability: The FNA measurements were derived from radiographs, which could introduce variability based on patient positioning, calibration of equipment and interpretation.

Lack of longitudinal data: A cross-sectional design provides a snapshot at a single point in time, which may not capture the dynamic changes in FNA and hip health over an individual's lifetime.

Potential confounders: There might be external factors, such as physical activity levels, dietary habits, or other underlying health conditions, which were not accounted for in the study. These could play a significant role in determining FNA and the onset of hip disorders.

Generalizability: As the study is based on data from a multi-center hospital database, the findings might be more representative of patients seeking medical care and less so of the general population.

Diagnostic variability: The prevalence of hip disorders is based on diagnoses that might have been made using varying criteria across different centers or periods, possibly introducing inconsistencies.

REFERENCES

1. Wang, Q.X., Y.J. Shang, Y.B. Ma, Y.S. Liu, Z.M. Liu and Y.T. Han, 2023. Correlations between the femoral neck osteotomy angle and radiologic and clinical outcomes analyzed in patients undergoing total hip replacement with metaphyseal fixation. Eur. Rev. Med. Pharmacol. Sci., 27: 5013-5022.
2. Ahmad, M.I.M., M.T. Bushra, A.T. Galal and S.M. Ouies, 2023. Computed tomography reference values estimation for femoral neck shaft angle in Egyptian healthy adults of both sexes. Egypt. J. Radiol. Nucl. Med., Vol. 54. 10.1186/s43055-023-01040-x
3. Clinger, B.N., S. Plaster, R.S. Fine, J.R. Marshall and D.L. Richter, 2023. Differences in CT scan measurements of femoral neck shaft angle and acetabular version among sex, age and ethnicity from a large cadaveric database. Western. J. Orthop., Vol. 12.
4. Che, S.H., M.R. Cho, P.M. Quinn and S.K. Song, 2023. Risk factors affecting hip fracture patterns in an elderly korean patient population. Medicine., Vol. 102. 10.1097/md.0000000000034573
5. Khalifé, M., C. Vergari, G. Rebeyrat, E. Ferrero, P. Guigui, A. Assi and W. Skalli, 2023. Femoral neck version in the spinopelvic and lower limb 3D alignment: A full-body EOS study in 400 healthy subjects. Eur. Spine J., 11: 1-9.
6. Çukurlu, M., B. Karagoz and O. Keceli, 2023. The effect of pre-fracture proximal femur geometry on hip fracture type in elderly patients. Medicine., Vol. 102. 10.1097/md.0000000000033622
7. Cong, B. and H. Zhang, 2023. The association between three-dimensional measurement of posterior tilt angle in impacted femoral neck fractures and osteonecrosis of the femoral head. BMC. Musculoskeletal. Disord., 24: 1-9.
8. Fang, L., J. Qi, Z. Wang, J. Liu, T. Zhao, Y. Lin and W. Hao, 2023. Inverse relationship between femoral lateralization and neck-shaft angle is a joint event after intramedullary nailing of per trochanteric fractures. Sci. Rep., Vol. 13. 10.1038/s41598-023-38209-3