Anatomical Dimensions of the Patella : Thai Cadaveric Study

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บทคัดย่อ : การศึกษามิติ ขนาดและรูปร่างของกระดูกลูกสะบ้าในศพดองคนไทย

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วัตถุประสงค์ : การศึกษานี้เพื่อรู้ขนาดและมิติของลูกสะบ้าในศพดองคนไทย **วิธีการ** : ลูกสะบ้า จำนวน 97 ลูก ในศพดองคนไทย ได้รับการวัดขนาดในมิติต่างๆ ทั้งความกว้าง ความยาว และความหนา โดยวิธีวัดด้วยเวอร์เนียร์แคลลิปเปอร์ชนิดเดียวกับที่ใช้ในการวัดขนาดของลูกสะบ้าในเวลาการทำผ่าตัดข้อเข่าเทียมและโดยวิธีการเข้าถึงลูกสะบ้าศพดองด้วยวิธีการผ่าตัดแบบเดียวกับการผ่าตัดจริงด้วย **ผลการศึกษา** : ค่าเฉลี่ยความหนามากที่สุดของลูกสะบ้าในศพดองคนไทย มีค่าเท่ากับ 22.08 มิลลิเมตร โดยมีค่าเบี่ยงเบนมาตรฐาน ±3.09 มิลลิเมตร ค่าเฉลี่ยความหนาที่น้อยที่สุด อยู่ที่ 12.39 มิลลิเมตร โดยมีค่าเบี่ยงเบนมาตรฐานที่ ±2.13 มิลลิเมตร ค่าเฉลี่ยความกว้างอยู่ที่ 36.18 มิลลิเมตร ค่าเฉลี่ยความยาวอยู่ที่ 33.25 มิลลิเมตร **สรุป** : ค่าเฉลี่ยความหนาของลูกสะบ้าในศพดองคนไทย อยู่ที่ 22.08 มิลลิเมตร และพอจะกล่าวได้จากการศึกษานี้ว่าหลังจากที่ตัดกระดูกลูกสะบ้าแล้วความหนาของกระดูกลูกสะบ้าเทียมที่ควรเลือกใช้ ควรอยู่ระหว่าง 7.5-8.5 มิลลิเมตร ซึ่งจะสามารถทำให้ลูกสะบ้าผู้ป่วยที่ได้รับการผ่าตัดข้อเข่าเทียมมีความหนาเท่าของเดิมและจะทำให้ข้อสะบ้าเข่าเทียมในผู้ป่วยสามารถกลับมาทำงานได้อย่างใกล้เคียงเป็นธรรมชาติที่สุด

คำสำคัญ : ความหนาของกระดูกลูกสะบ้าเข่า ศึกษาในศพดอง ข้อสะบ้าเข่าเทียม

Abstract

Objective : This study reports on the anatomical dimensions of the patella in Thai cadavers. **Methods** : A total of 97 cadaverics patella were measured by using a vernier caliper. The height, width, the maximum thickness at the ridge of the patella was measured. The standard deviation and the mean of the various measurements were calculated. The various measurement parameters were compared with emphasis on the maximum and minimum thickness. **Results** : The mean maximum thickness of patella was 22.08 mm. with a SD of 3.09 mm. The mean minimum thickness of patella was 12.39 mm. with a SD of 2.13 mm. The mean width of patella was 36.18 mm. with a SD of 3.28 mm. and the mean height was 33.25 mm. with a SD of 1.94 mm. **Conclusion** : The mean maximum thickness of Thai cadaveric patella was 22.08 mm. which was similar to other studies and from this study we concluded that after patellar bone cut the thickness of the patellar implant that appropriate should be 7.5 mm to 8.5 mm. So this could restore the normal patella thickness in total knee arthroplasty.

Keywords : Patellar Thickness, Cadaveric Study, Patellar Component

Introduction

Patella-related problems are common during and after Total Knee Replacement[1-2]. Anatomical dimensions of the patella namely the thickness, height and width ratio, and the relative position of the median ridge all have implications relating to the selection of patellar component of total knee arthroplasty, patellar tracking in the trochlear groove and patellofemoral contact stress.[1-2] Information regarding anthropometric patellar dimensions, especially the thickness can play a very important role during the design of patellar component and the development of surgical techniques.

Re-creating physiologic patella thickness after resurfacing plays an important role in total knee arthroplasty. Aim should be re-establish patellar thickness.[1-2] The preparation of the patella should be preserved 12 to 15 mm of bone thickness and it is recommended to maintain an overall thickness to at least 1/3 of the original size of the patella in order to prevent over stuffing and complications associated with it.[1,3-4] This may be difficult if the patella is affected by advanced degenerative change, severe deformation, or erosion, all of which will invariably distort the surface anatomy. Under those circumstances, one should aim at reestablishing average patellar thickness in men and women which is surprisingly constant, with values ranging from 22 to 24 mm.[1,5-6] Greenfield[1] reduced the incidence of lateral retinacular release from 55% to 12% by ensuring that the overall patellar thickness was less than or equal to that of the native patella. It would therefore appear satisfactory to keep the composite height of the patella slightly below the level of the native patella. Reducing the overall thickness by 1 to 2 mm. in an attempt to improve patellar tracking has been recommended.[1]

As already mentioned we found no literature of a cadaveric study of the patella by using a vernier caliper. The rationale was that this is the method by which the patella is measured intraoperatively and is also a comparatively cheaper method as compared to other radiographic methods although studies done by these methods may yield a more accurate reading but we believe it will not be significant.

The objective of this study was to measure the anthropometric measurements of the patella in Thai cadavers using the vernier caliper with importance to the thickness of the patella as this is the measurement that determines the size of the patellar component.

Materials and Methods

The study was performed at the Department of Anatomy, Siriraj hospital, Bangkok after approval from the ethical board. The study sample was calculated to be 88 patellas. All available cadaveric patella specimens at Department of Anatomy, Siriraj hospital were included in this study. The exclusion criteria were cadavers above the age of 70 years as we believed that the native structure of the patella would be unrecognizable, patella in which there was a previous surgical procedure, patella that remained unrecognizable even after dissection. The sample size was calculated with a confidence interval of 95% (1.96), margin of error being 0.5 mm and a standard deviation of 2.3.[1,7] The vernier caliper was used to measure the dimensions of the patella and it had an error margin of 0.05 mm.[1] This method was chosen as it is usually the method used intraoperatively to measure the patella before resurfacing and is comparatively a cheaper method.[1,8] We were provided with a list of the cadavers with the age, sex and identification number of the cadavers with no other data available. On tallying with the list only 78 cadavers were physically available and were all Asian. Out of the 78 cadavers, 24 were further excluded as the patella was grossly deformed or had previous surgery. Patella was measured in 54 cadavers out of which 33 were males and 21 females. 45 patellas was measured on the right side and 52 on the left side. 9 patella was not available on the right side and 2 on the left side. Total number of patella measured was 97. The patellas was independently measured by a senior orthopedic surgeon with years of experience in total knee arthroplasty, 2 senior orthopedic residents and 2 junior orthopedic residents.

To facilitate measurement : a median or paramedian retinacular approach was used similar to the incision used in total knee arthroplasty. Following superficial dissection the patella was exposed and everted. The synovial tissue around the patella was sharply incised and the peripheral osteophytes were removed using a bone rounger before proceeding with the measurements.[1,8] Following exposure of the patella the height was measured from the base to the apex of the patella or from the superior pole to the inferior pole. The width was measured from the lateral border to the medial border of the patella. At the lateral facet the thickness was measured at the shallowest part of the facet and a point corresponding directly opposite to it. The area of maximum thickness was measured at the highest point at the patellar ridge and to a point directly opposite to that point. The thickness at the medial facet was measured at the thickest part of the facet and a point corresponding directly opposite to it.[3,5,7,9-11]

Results

The demographic data provided did not yield much information other than the age and sex of the patient. From the 54 cadavers there were 21 females accounting to 39% and 33 males accounting to 61% of the total cadavers. There were 12 cadavers between the ages of 41 years to 50 years, 16 cadavers between the ages of 51 years to 60 years and 26 cadavers between the ages of 61 years and 70 years. The mean age was 59.3 yrs with a SD of 8.19. Although the data was collected for various measurements, the focus was on the patellar thickness as this determined the size of the patellar component after resurfacing. The maximum thickness of the patella was a mean of 22.08 mm. with SD of 3.09 mm. measured at the ridge of the patella. The mean thinness was calculated to be 12.39 mm. with SD of 2.12 mm. which was measured at the lateral facet of the patella. The mean thickness measured at the medial facet of the patella was 19.65 mm. with a SD of 3.00 mm. The mean height which was measured from the superior pole to the inferior pole was 38.18 mm. with a SD of 3.28 mm. The mean width was 33.25 mm. with a SD of 1.94 mm. which was measured from the lateral border to the medial border of the patella. The various measurements are shown in the table below.

	Mean (mm.)	Standard deviation (mm.)
Height of patella, right side	34.07	1.64
left side	33.05	2.50
Width of patella, right side	38.65	3.29
left side	37.09	3.14
Medial thickness, right side	18.88	2.96
left side	18.75	3.02
Lateral thickness, right side	13.05	1.76
left side	11.78	1.62
Maximum thickness right	22.50	3.07
Maximum thickness left	21.05	3.00

Various companies patella components were analyzed and most commercially available patella components thickness were ranged from 7.5 to 14 mm. In this study, after did bone cut of the patella to about 12-15 mm., patella components required would range from 7.5-8.5 mm. to recreate the original patella thickness.[1,3-4]

Discussion

The patella is vital for optimal knee movement. Complications can occur during or post total knee arthroplasty. This study was done in cadavers using a vernier caliper as this is the method used most commonly intraoperatively to measure the patella before resurfacing and deciding the size of the patella component. Various other studies have been done using plain x rays, CT which may be more accurate but are considerably much more expensive and are usually not the method used intraoperatively.[7,8,10] The results of this study were similar to other studies conducted with no significations difference between the method of measurements. Suliman[12] in their study measurement of patellar thickness in relation to patella resurfacing using plain radiographs in 56 patients showed an average thickness 23.2 (20.2-26.2 mm.). Jiang[13] in their study patellar thickness in TKA reported an average thickness 21.2 +/- 1.8 mm. These results were similar to this study which had maximum thickness of the patella had a mean of 22.08

with SD of 3.09 measured at the ridge of the patella. There were various limitations to this study, firstly the cadavers were available for only a very short period of time when the measurements could be done and were not available after that. Human error can be considered as one of the limitations but this can be negated due to the fact that it is the same method used to measure patella intraoperatively. Re-creating physiologic patella thickness after resurfacing is important. Aim should be to re-establish patellar thickness. The preparation of the patella should aim to preserve - 12 to 15 mm. bone and it is recommended to maintain an overall thickness of patient patella to at least 1/3 of the original size of the patella in order to prevent over stuffing and complications associated with it.[1,3-4]

Conclusion

The mean patellar thickness was ranged from 22.08 mm. with a SD of 3.09 mm. similar to the results achieved by using other methods of measurements. For this population we concluded that the size of patellar component in total knee arthroplasty would range from 7.5-8.5 mm. So this could restore the normal thickness of the patella in total knee arthroplasty paient.

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