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PATHOLOGICAL ANATOMY OF THE AGING MENISCUS

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Changes in the menisci of the knee joint due to the aging process have been well recognized in several studies in recent years (Chand 1972, Sideman & Siegel 1962, Smillie 1968). Horizontal lesions of the knee meniscus have been specially referred to by Smillie (1968) in his series of 3,000 cases, wherein 50 per cent of the tears were horizontal, and the average age was 43 years. Chand (1972), in an autopsy study of 22 knee joints in Scottish males and females, found a high incidence of medial meniscal tears in 14 out of 22 male knees and six out of 22 female knees, and lateral meniscus tears in one out of 22 male knees and two out of 22 female knees. In a series of 35 knees in 31 patients over the age of 50 years, with complaints of pain and swelling over the anteromedial aspect of the knee and limitation of motion, Lidge (1970) found marked degeneration of the meniscus with fraying and shred-like areas throughout.

With advancing age, the knee meniscus becomes harder and loses its elasticity. The color changes to yellow in places and it becomes transluscent at the thin medial border. Microscopically, there is a gradual loss of cellular elements with empty spaces and an increase in the amount of fibrous tissue in comparison to elastic tissue (Helfet 1971). These cystic areas are the start of a tear and with a torsional force imparted by the over-lying femoral condyle, the superficial layers of the meniscus are sheared off from the deep one along the interface of the cystic degenerative change, thus producing a horizontal cleavage tear in the meniscus. The torn meniscus infringes upon the medial condyle of the femur near the intercondylar notch, producing erosion of the articular cartilage and setting the stage for osteoarthritis (Helfet 1971). The meniscal tear can also occur in osteoarthritis secondary to articular incongruity and abnormal joint excursion (Sideman & Siegel 1962). Equally, the process of degeneration of menisci and articular

cartilage may be due to a similar etiology, i.e. the aging process and mechanical incongruity of the knee joint.

This study was undertaken to investigate the pattern of degeneration in the menisci of the knee joint due to the aging process. A detailed dissection of the knee joints in 21 autopsy specimens and 25 anatomy cadavers, giving a total of 46 subjects, was carried out.

MATERIALS AND METHODS

In the dissection of the knee joints the following degenerative changes in the menisci were recognized:

a) Yellow areas;
b) Fraying of the cartilage – at both ends;
– along the concave border;
c) Horizontal tears in the meniscus;
d) Calcified spots.

The yellow areas were apparent over the surface of the meniscus as linear streaks or irregular areas. The cartilage over the surface felt soft to pointed pressure, and on section the area extended one-third of the way through the thickness of the cartilage. These areas were the earliest signs of degeneration in the cartilage.

Fraying of the cartilage was noticed either along the concave border, especially in the posterior third, or in the anterior horn which on occasions was partly detached. Multiple fine strands of fibers appeared, like a brush.

Horizontal tears in the meniscus always originated on the free concave border and extended for a variable length towards the posterior horn. The tear involved about one-third of the thickness of the meniscus near the middle of the cartilage although it included the whole of the free concave border. The tear did not extend as far laterally as the peripheral capsular border of the meniscus. Longitudinally, the tear extended along the yellow streak on the surface of the meniscus. Detachment of the tear from the posterior horn was not observed, though when it originated anteriorly, detachment from the anterior horn was seen.

Calcified spots were identified as white specks or areas over the surface of the meniscus and gave a gritty feeling when cut across with a knife.

RESULTS

Total number of subjects: 46
Total number of knee joints studied: 90
Degenerative changes in the menisci. Total knees studied: 90

a) Yellow areas (Total 80 menisci):

Anterior one-third	7	(Medial 3; lateral 4)
Middle third	27	(Medial 14; lateral 13)
Posterior third	46	(Medial 17; lateral 29)

b) Fraying (Total 65 menisci):

Anterior one-third	3	(Medial	3;	lateral	0)
Middle third	47	(Medial	22;	lateral	25)
Posterior third	15	(Medial	8;	lateral	7)

c) Horizontal tears (Total 39) Medial 32; lateral 7:

Anterior one-third	6	(Medial	5;	lateral	1)
Middle third	14	(Medial	11;	lateral	3)
Posterior third	19	(Medial	2;	lateral	3)

d) Calcification (Total 8):

Anterior one-third	2	(Medial	8;	lateral	0)
Middle third	1	(Medial	1;	lateral	0)
Posterior third	5	(Medial	3;	lateral	2)

Autopsy specimens: 21 subjects

Articular Damage and Menisceal Tear:

No articular damage	3 patients
Minimum articular damage	8 patients
Moderate articular damage	7 patients
Severe articular damage	3 patients

Age Group Distribution of Subjects with Horizontal Tears:

51–60 years	2
61–70 years	8
71–80 years	6
81–90 years	5

Autopsy specimens: 21, cadavers: 25 (Total 46)

Sex Distribution of Subjects with Horizontal Tears:

Male	12 out of 24	(or 50	per cent)
Female	9 out of 22	(or 40.9	per cent)

Racial Distribution of Subjects with Horizontal Tears:

Black (Negro)	15 out of 32	(or 46.9	per cent)
White (Caucasian)	6 out of 14	(or 42.8	per cent)

DISCUSSION

A review of the results indicates that the degenerative changes in the menisci of knee joints progress concurrently with the degenerative

Table 1. Correlation between meniscus regeneration and osteoarthritis of the knee.

Age group	No. of knee joints	Meniscus degeneration						Osteoarthritis					
		Yellow area		Fraying		Horizontal tears		Fibrillation		Erosion		Eburnation	
		M.	L.	M.	L.	M.	L.	M.	L.	M.	L.	M.	L.
11–20	2	1	1	1	1	nil	nil	nil	nil	nil	nil	nil	nil
21–30	2	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
31–40	6	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
41–50	4	1	1	1	1	nil	nil	nil	nil	1	1	nil	nil
51–60	10	5	4	3	2	1	nil	4	1	4	1	1	nil
61–70	28	14	16	13	6	11	2	22	11	24	11	17	5
71–70	20	13	10	12	11	4	3	12	12	12	11	5	5
81–90	18	16	12	12	11	8	3	11	11	11	11	9	9

M. = Medial.
L. = Lateral.

process in the rest of the joint. Thus, symptoms produced by a degenerative meniscus, viz. those produced by a horizontal tear in middle age, can only be considered and treated as an aspect of an overall degenerative joint disease rather than as an isolated lesion. It is not until the sixth decade that these lesions in the menisci start appearing in appreciable numbers and seem to precede the degenerative change in the articular cartilage. Later in the seventh, eighth and ninth decades, the articular damage is predominant and degenerative menisci are persistently seen along with it. There is a slight preponderance of black males as far as incidence of horizontal tears in the menisci are concerned. As expected, lesions in the medial meniscus predominate.

In a series of 35 knees in 31 patients, Lidge (1970) found two anteromedial tears, ten tears along the medial margin, nine tears in the posterior horn, four posteromedial tears and ten classified as diffuse degeneration and multiple fraying. Adhesive synovitis at the site of the junction of the medial meniscus with the collateral ligament has been thought to lead to early detachment of the meniscus in the middle third. Medial menisectomy has led to relief of symptoms in the majority of patients in this series. However, Appel (1970), while reviewing late results of menisectomy, found that degenerative osteoarthritis occurs with a significantly higher frequency after menisectomy—10.8 per cent in operated as against 0.9 per cent in non-operated cases. Age at operation, longer latency period, trauma as the etiologic

factor did not influence the final result, nor did partial or total extirpation of the meniscus or early or late postoperative weightbearing. Radiological evidence of osteoarthritis before surgery was associated with unsatisfactory results.

Jackson (1968) in a review of 577 knees five years after menisectomy found a higher incidence of degenerative arthritis following menisectomy. Helfet (1961) has indicated that the erosion of the medial femoral condyle is associated with, and is a result of, a tear of the anterior horn. In this study, whenever such a lesion in the medial condyle was observed, it was not an isolated lesion but there were degenerative changes in the articular cartilage in other parts of the joint. Perhaps a concomitant degenerative process in the articular cartilage, added to the repeated trauma of the torn anterior horn, makes the association of these two lesions more pronounced.

Wiley (1968), in a study of 114 menisci from cadavers of 30 patients, found only four torn medial menisci and degenerative changes predominantly in the lateral compartment of the knee. This is in contrast to the findings from this study wherein the medial meniscus and the medial compartment have been found to be more predominantly involved.

SUMMARY

In 21 autopsy subjects and 25 anatomical cadavers, both knee joints were dissected extensively to find: a) degenerative changes in the menisci of knee joints, especially horizontal tears and b) associated degenerative changes in the articular surfaces of the knee joint, in order to attempt a correlation between the two lesions.

Thirty-nine horizontal tears of the meniscus in 21 patients were found, of which 32 were in the medial meniscus. There was no articular damage visible in three, minimal in eight, moderate in seven and severe in three subjects. The highest incidence was in the seventh and eighth decades with black males showing a slight preponderance.

The degenerative meniscus with a horizontal tear is a part of the overall degenerative process in the knee joint and should be treated as such.

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