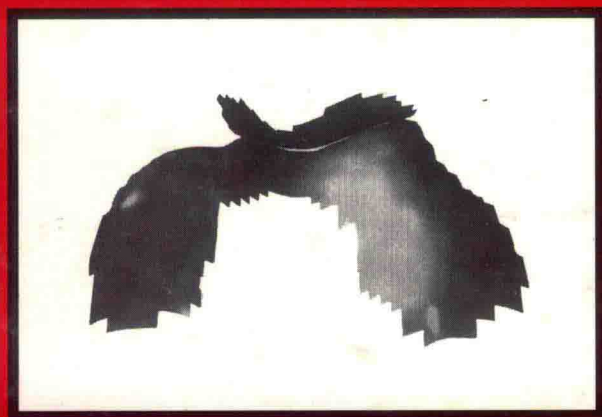


# The Patella

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A Team Approach



Ronald P. Grelsamer  
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AN ASPEN PUBLICATION

# **The Patella**

## **A Team Approach**

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*To my wife and best friend Sharon who gave up many an evening and weekend while I sifted through references, sat at the computer, or padded our long-distance phone bill.*

*To my children Dominique and Marc from whom I constantly learn and to my parents who made my education possible!*

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# Preface

Twenty years ago when Ficat and Hungerford published a book on disorders of the patella, the question was “why an entire book on the patella?” Today the question could be “why another book on the patella?” Indeed, since the publication of Ficat and Hungerford’s seminal book, there have been two English-language books on the subject and two further editions of the original work.

*The Patella: A Team Approach* represents the collaborative editorial efforts of an orthopaedic surgeon and a physical therapist, and the chapters have been written by an orthopaedic surgeon, two physical therapists, and a podiatrist. This reflects the well-accepted opinion that most patellofemoral problems can be addressed by an appropriate nonoperative program.

This book is designed to help the health professional deal with the patient who presents with what is often referred to as “patellar pain.” There are no chapters on patella fractures or quadriceps or patellar tendon ruptures; nor is there a chapter on the patella in total knee replacement surgery. These subjects are very well covered in other texts. On the other hand, this book addresses topics not addressed in other books on the pa-

tella. Chapters on controversies (Chapter 1), classification of patellofemoral disorders (Chapter 9), the foot and orthotics (Chapter 13), taping (Chapter 12), and the failed patella (Chapter 15) all contribute to making this work significantly different.

Medical texts fall into two categories: multiauthor and single-author works. Each approach has its pros and cons. Multiauthor texts provide varying points of view, but the information presented may be contradictory. Single-author texts provide a more unified approach, but they reflect the author’s bias. Although this book is technically a multiauthor text, it is conceptually a single-author text; all chapters have been written by or under the umbrella of the two senior authors. Although we have tried to separate fact from opinion and to present different points of view, our biases surely shine through.

It is our hope that health professionals who read this book will gain an appreciation of the fundamental concepts and the numerous controversies surrounding the patella.

Ronald P. Grelsamer, MD  
Jenny McConnell, PT, GDMT, MBiomedE

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Jenny McConnell, PT, GDMT, MBIomedE, from Australia, has made terrific contributions to the treatment of patellar disorders. It has been a privilege to have her as a coeditor (my local phone company will be sorry to see this project come to its conclusion). I thank Lloyd Hines, PT, for introducing us.

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My earliest mentor Howard Kiernan, MD, was the first to point out to me that patella malalignment is underdiagnosed and over-operated. Nas Eftekhari, MD, has always stressed the importance of careful preoperative screening in orthopaedic surgery.

My colleagues and residents at the Maimonides Medical Center, the Hospital for Joint Diseases, and the Beth Israel Medical Center in New York have constantly queried and questioned the concepts in this book, and I am grateful for their intellectual stimulation.

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On behalf of patients who will be helped by this book, to all of you I say thank you!

*Ronald P. Grelsamer, MD*



# Table of Contents

<b>Contributors</b> .....	<b>ix</b>
<b>Preface</b> .....	<b>xi</b>
<b>Acknowledgments</b> .....	<b>xiii</b>
<b>Chapter 1—What Causes Pain? and Other Fundamental Controversies</b> .....	<b>1</b>
Nomenclature: The Tower of Babel .....	1
What Causes Patellar Pain? .....	4
Why Aren't All Malaligned Patellae Painful? Why Does Only One Knee Hurt? .....	5
How Are Pain and Instability Related? .....	6
What Will Replace the Term <i>Chondromalacia</i> ? .....	6
Does Patella Malalignment Lead to Knee Arthritis? .....	7
Can There Be Pain in the Absence of Cartilage Lesions? .....	7
Are There Differences Between Adults and Adolescents with Knee Pain? .....	7
<b>Chapter 2—Normal and Abnormal Anatomy of the Extensor Mechanism</b> .....	<b>11</b>
Embryology .....	11
Normal Anatomy .....	11
Abnormal Anatomy .....	20
<b>Appendix 2—A: Analysis of Vastus Medialis Longus and Vastus Medialis Obliquus Characteristics</b> .....	<b>24</b>
<b>Chapter 3—Applied Mechanics of the Patellofemoral Joint</b> .....	<b>25</b>
The Patella—A Lever or a Pulley? .....	25
The Quadriceps (Q) Angle .....	27
Patellofemoral Contact Area .....	28
Contact Load (Joint Reaction Force) and Pressure .....	30
Patella Tracking .....	32
Material Properties of Patellofemoral Cartilage .....	35
Gait Analysis .....	35
In Vitro Techniques—Present and Future .....	35
Interactive Manipulation of Joint Surface Models .....	36

	Future Directions .....	37
	<b>Appendix 3—A: Derivation of Effective Moment Arm .....</b>	<b>41</b>
<b>Chapter 4—The History and Physical Examination: The Orthopaedist's Perspective ...</b>		<b>43</b>
	The Medical History .....	43
	The Physical Examination .....	44
<b>Chapter 5—Patellofemoral Imaging .....</b>		<b>57</b>
	Plain Radiographs .....	57
	Technetium Scanning .....	69
	Computed Tomography and Magnetic Resonance Imaging .....	69
	An Algorithm .....	74
<b>Chapter 6—Patellar Instability .....</b>		<b>79</b>
	Atraumatic Instability .....	79
	Traumatic Disruptions of the Extensor Mechanism .....	80
<b>Chapter 7—Nontraumatic Conditions Related to Malalignment .....</b>		<b>87</b>
	Osgood-Schlatter's Condition .....	87
	Bipartite Patella .....	88
	The Dorsal Defect .....	89
	Patellar Duplication .....	89
	Patellar Tendinitis .....	90
	Patellar Tendon Rupture .....	90
<b>Chapter 8—Patellar Pain Not Related to Malalignment: Differential Diagnosis .....</b>		<b>93</b>
	Neuroma .....	93
	Iliotibial Tendinitis .....	93
	Plica Syndrome .....	94
	Patellar Tendinitis (Jumper's Knee) .....	94
	Fat Pad Syndrome .....	96
	Sinding-Larsen-Johansson Syndrome .....	96
	Anterior Cruciate Ligament Tear .....	96
	Quadriceps Atrophy .....	96
	Tumors .....	96
	Rheumatological Conditions .....	97
	Osteochondritis Dissecans .....	97
	Lyme Disease .....	99
	Reflex Sympathetic Dystrophy and RSD-Like Conditions .....	99
	Infection .....	99
	Referred Pain .....	99
	Overuse .....	99
	Stress Fracture .....	99
	Other Causes of Patellar Pain .....	100
<b>Chapter 9—Classification of Patellofemoral Disorders .....</b>		<b>103</b>
	Nomenclature and Classification of Chondral Lesions .....	103

Nomenclature and Classification of Patellofemoral Disorders .....	105
Histology .....	106
Proposed Classification of Patellofemoral Symptomatology .....	106
<b>Chapter 10—Examination of the Patellofemoral Joint: The Physical Therapist's</b>	
<b>Perspective</b> .....	<b>109</b>
The Patient's History .....	109
Symptoms .....	109
Clinical Examination .....	110
<b>Chapter 11—Conservative Management of Patellofemoral Problems</b> .....	<b>119</b>
Symptom Reduction .....	119
Unloading .....	123
Muscle Training .....	124
Specificity of Training .....	126
Environment .....	126
Training the Vastus Medialis Obliquus .....	127
Progression of Treatment .....	129
Foot Problems .....	131
Weaning from Tape .....	131
Conclusion .....	135
<b>Chapter 12—Surface Electromyography and Patellofemoral Dysfunction</b> .....	<b>137</b>
<i>Glenn S. Kasman</i>	
Overview .....	137
SEMG Background .....	137
SEMG and the Patellofemoral Joint .....	140
Case Histories .....	156
Conclusion .....	159
<b>Appendix 12—A: Surface Electromyographic Application Guide for</b>	
Patellofemoral Pain Syndrome .....	165
<b>Chapter 13—Biomechanical Management of Patellofemoral Pain and Dysfunction with</b>	
<b>Foot Orthotic Devices</b> .....	<b>177</b>
<i>John E. McNerney</i>	
Introduction .....	177
Practical Biomechanics of the Lower Extremity .....	177
Factors That Alter Normal Biomechanics and Kinematics of Gait .....	184
The Knee in Gait, Normal Function, and Dysfunction .....	194
Research .....	196
Foot Orthotic Devices .....	202
Classification of Foot Orthotic Devices .....	204
The Design of Orthotic Devices .....	217
Successful Use of Orthotics in Patients with Knee Dysfunction .....	220
Conclusion .....	223

**Chapter 14—Surgery** ..... **229**  
    Indications ..... 229  
    Informed Consent ..... 230  
    General Principles ..... 230  
    Specific Procedures ..... 231  
    Anesthesia ..... 251  
    Author’s Opinion ..... 252

**Chapter 15—The Failed Patella** ..... **257**  
    Overview ..... 257  
    Mechanical Pain ..... 257  
    Biological Pain—Reflex Sympathetic Dystrophy and RSD-Like Conditions ... 258  
    Emotional Pain ..... 261

**Index** ..... **265**



# Classification of Patellofemoral Disorders

Many classifications of patellofemoral disorders have been published. Some address the specific source of the pain, some address only the appearance of the chondral lesions, some factor in the radiographic appearance of the patellofemoral joint, some combine all of these elements. This chapter outlines some of the existing classifications and presents a proposed classification.

### NOMENCLATURE AND CLASSIFICATION OF CHONDRAL LESIONS

What to call a traumatic or degenerative abnormality of articular cartilage is a source of controversy. *Chondromalacia* is not always technically correct and has too many negative connotations (see Chapter 1). *Chondritis* implies an inflammation, which is not present. *Chondropathy* is better suited to metabolic disorders. For the moment, the term *chondral lesion* seems most suitable.

A number of classifications of chondral lesions have been described, most of which feature four stages of cartilage degeneration. The fourth stage usually implies degeneration down to visible subchondral bone.

#### Outerbridge Classification

In 1961, Outerbridge<sup>1</sup> proposed the following stages of “chondromalacia patellae”:

- *Stage I*: change of color from glistening white to dull and yellowish white; abnormal softening
- *Stage II*: fissuring and fragmentation, less than 1.25 cm
- *Stage III*: fissuring and fragmentation, greater than 1.25 cm
- *Stage IV*: erosion down to bone

Outerbridge found this pathology to be most common on the medial facet and attributed it to an abnormal ridge superomedial to the trochlea.

#### Ficat and Hungerford Classification

The Ficat and Hungerford<sup>2</sup> classification is based on “axial X-rays” (actually arthrography).

1. chondromalacia of the lateral facet
2. chondromalacia of the odd facet
3. central chondromalacia with symmetric extension medially and laterally
4. bipolar chondromalacia involving “the central portion of the two facets separated by a normal median ridge”
5. global chondromalacia or total chondromalacia involving the “totality of both facets”

Ficat and Hungerford characterized chondral lesions as *early* and *late*,<sup>3</sup> defined as follows:

- *Early*: “closed chondromalacia” with swelling and blistering; found most commonly on the lateral portion of the patella and attributed to excessive pressure

- *Late*: open lesion with fissures or ulcerations

### Goodfellow Classification

Goodfellow et al<sup>4</sup> developed the following classification system:

- Grade I: Blister formation with basal degeneration; most commonly at distal part of ridge separating medial and lateral patella (Note: This ridge is not always present, see Chapter 2.)
- Grade II: Superficial degeneration most commonly along the odd facet thought to be secondary to decreased contact; starts with flaking and progresses to fibrillation and fissure formation
- Grade III: ulceration
- Grade IV: crater formation and subchondral eburnation

### Insall Classification

Insall developed the following classification system<sup>5,6</sup>:

- I: softening and swelling (blister)
- II: deep fissuring down to subchondral bone
- III: fibrillation ("crab meat")
- IV: thinning, coarse granular appearance of cartilage, exposure of subchondral bone

### Casscells Classification

In 1982, Casscells<sup>7</sup> proposed the following classification system for "chondromalacia":

- I: superficial erosion  $\leq 1$  cm
- II: involvement of deeper cartilage layers (1 to 2 cm)
- III: complete erosion of cartilage with exposure of subchondral bone (2 to 4 cm)
- IV: completely destroyed cartilage "wide area"

### Bandi Classification

Bandi<sup>6,8</sup> proposed the following classification system for "chondromalacia" in 1982:

- I: softening, cartilage edema
- II: fragmentation and fissuring down to subchondral bone
- III: exposure of subchondral bone with sclerosing

### Bentley Classification

Bentley<sup>9</sup> proposed the following classification system for "chondromalacia" in 1984:

- I: fibrillation or fissuring  $< 0.5$  cm
- II: fibrillation or fissuring 0.5 to 1 cm
- III: fibrillation or fissuring 1 to 2 cm
- IV: fibrillation with or without exposed subchondral bone  $> 2$  cm

### Bauer and Jackson Classification

In 1988, Bauer and Jackson<sup>10</sup> developed the following classification system for femoral condyle lesions:

- Acute traumatic condyle lesions
  - I: linear crack
  - II: stellate fracture
  - III: flap
  - IV: crater
- Degenerative condyle lesion
  - V: fibrillated
  - VI: degradation

### Noyes and Stabler Classification

Noyes and Stabler<sup>11</sup> developed the following system for grading articular cartilage lesions at arthroscopy:

- I: cartilage surface intact
- IA: softening  $< 1$  cm
- IB: softening (deformation)  $\leq 1.5$  cm
- II: cracks, fissuring, fibrillation, fragmentation
- IIA: cracks, fissuring, fibrillation, fragmentation  $< \frac{1}{2}$  thickness
- IIB: cracks, fissuring, fibrillation, fragmentation  $> \frac{1}{2}$  thickness
- III: bone exposed
- IIIA: bone surface intact
- IIIB: bone surface excavation

(*Note:* Blunt trauma to the knee may not cause visible injury to the articular cartilage. Nevertheless, damage can be caused to the deeper layers.<sup>12-14</sup> At the time of publication, this damage is not visible on any form of imaging including magnetic resonance imaging. This deep layer damage can eventually be associated with more extensive damage to an extent that is not currently predictable.)

## NOMENCLATURE AND CLASSIFICATION OF PATELLOFEMORAL DISORDERS

Patellofemoral disorders can be classified in a number of ways. The main differential diagnosis in my opinion is whether the pain is related to malalignment. There is a gray area to the extent that some conditions such as patellar tendinitis and Osgood-Schlatter's condition can only occasionally be linked to malalignment.

There are many parameters to consider in putting together a classification: the status of the patellofemoral articular surface, the three-dimensional positional position of the patella within the patellofemoral joint, abnormalities of the limb above and below the patella, and structural abnormalities about the patellofemoral joint itself.

### Outerbridge Classification

Outerbridge<sup>15</sup> classified "chondromalacia patellae" in 1975 in the following manner:

- A. Trauma (directly to the patella)
- B. Dislocation (acute or recurrent; with or without a tear of the medial capsule, a medial patellar fracture, or an osteochondral "flake")
- C. Malalignment syndrome with patellar subluxation
  - 1. factors increasing quadriceps bow-string effect
    - a. female, wide pelvis
    - b. valgus knees
    - c. excessive laterally placed tibial tubercle

- d. congenitally flattened lateral femoral condyle
  - e. patella alta
- 2. lax medial capsular retinaculum
  - a. tear following dislocation
  - b. stretching secondary to
    - i. tight lateral capsular retinaculum
    - ii. chronic joint fluid
    - iii. repetitive subluxation
- 3. inefficient vastus medialis muscle
  - a. congenitally high insertion
  - b. atrophy of disuse
- 4. congenitally tight lateral capsular retinaculum
- 5. acute dislocation of athletes
- D. Normal knee alignment with osteochondral ridge
- E. Increased cartilage vulnerability
  - 1. congenital
  - 2. postarthrotomy rehabilitative period
  - 3. postcasting rehabilitative period
- F. Occupation hazards
  - 1. military and athletic trainees
  - 2. jobs requiring excessive kneeling and squatting

### Fulkerson-Schutzer Classification

Fulkerson and Schutzer<sup>16,17</sup> have devised a classification combining chondral changes and three-dimensional patellar positioning.

- Type I
  - A. patellar subluxation with no articular lesion
  - B. patellar subluxation with grade 1-2 chondromalacia
  - C. patellar subluxation with grade 3-4 arthrosis
  - D. patellar subluxation with a history of dislocation and minimal or no chondromalacia
  - E. patellar subluxation with a history of dislocation, with grade 3-4 arthrosis
- Type II
  - A. patellar tilt and subluxation with no articular lesion



- B. patellar tilt and subluxation with grade 1–2 chondromalacia
- C. patellar tilt and subluxation with grade 3–4 arthrosis
- Type III
  - A. patellar tilt with no articular lesion
  - B. patellar tilt with grade 1–2 chondromalacia
  - C. patellar tilt with grade 3–4 arthrosis
- Type IV
  - A. no malalignment and no articular lesion
  - B. no malalignment and grade 1–2 chondromalacia
  - C. no malalignment and grade 3–4 arthrosis

### Merchant Classification (Abridged)

Merchant<sup>18</sup> developed the following classification for patellofemoral disorders:

- I. Trauma (conditions caused by trauma in the otherwise normal knee)
  - A. acute trauma
  - B. repetitive trauma (overuse syndromes)
    - 1. patellar tendinitis (jumper's knee)
    - 2. quadriceps tendinitis
    - 3. peripatellar tendinitis (anterior knee pain of the adolescent secondary to hamstring tightness)
    - 4. preoperative patellar bursitis (housemaid's knee)
    - 5. apophysitis (Osgood-Schlatter, Sinding-Larsen-Johansson)
  - C. late effects of trauma (eg, arthritis, patella infera, reflex sympathetic dystrophy)
- II. Patellofemoral dysplasia
  - A. lateral patellar compression
  - B. chronic subluxation of the patella
  - C. recurrent dislocation of the patella
    - 1. associated fractures (osteochondral, avulsion)
    - 2. secondary chondromalacia
    - 3. secondary arthritis
- III. Idiopathic chondromalacia patellae

- IV. Osteochondritis dissecans
- V. Synovial plicae (symptomatic)

### HISTOLOGY

One of the hallmarks of patellar malalignment is a change in the articular cartilage of the patella. This change is to a certain extent visible—and, thus, the name *chondromalacia*. Again it must be emphasized that pain from patellar malalignment can be present even if there are no visible changes in the articular cartilage. Furthermore, there can be significant histological changes in the absence of any grossly discernible changes in articular cartilage.<sup>12</sup> These changes can also be noted on electron microscopy.<sup>19</sup>

When edema is present, there is a decrease in cell density, a reduced and uneven level of fast green (SO) staining down to the deepest areas of cartilage, and a suggestion that proteoglycan synthesis is greatly decreased.<sup>12</sup> In advanced lesions, Mori et al have noted a large number of undifferentiated mesenchymal cells and fibroblast-like cells about the fissures. These features are absent in patients with osteoarthritis unrelated to patella malalignment.<sup>12</sup>

### PROPOSED CLASSIFICATION OF PATELLOFEMORAL SYMPTOMATOLOGY

Rather than include all elements of the classification of patellofemoral symptomatology in one table, it is perhaps better to divide the classification into subgroups. This concept was first proposed by Merle d'Aubigné<sup>20</sup> in 1954 for describing hip function (his subgroups were pain, motion, and activities). Lewandowski et al<sup>6</sup> also recently used this concept when they broke down articular cartilage lesions of the knee into six groups: appearance, depth, area, clinical stage (ie, acute/chronic), location, and severity.

I propose a classification divided into three subgroups: etiology (source of pain), radiology, and a description of the chondral lesions.