The Achilles heel of adults and children

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EPONYMS OF THE KAGER TRIANGLE

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INTRODUCTION

The area of the Kager triangle contains numerous structures, diseases, approaches, or tests that are described with the use of eponyms1-6. Even the triangle itself is an eponym, named for Dr. Hans Kager 7. The Kager triangle, also known as the pre-Achilles fat pad, is the region bordered by the superior part of the calcaneus, the flexor hallucis longus tendon, and the Achilles tendon 7,8.

Much has been written about eponyms 9,10, and the use or misuse of eponyms has been discussed previously 11-14. Recent publications have questioned whether eponyms should be used in medical practice or merely be reserved for use by those interested in the historical perspective 15-17, but, to date, no consensus has been reached. Although the use of eponyms can cause confusion for scientific and clinical purposes, they remain a tribute to the pioneers of anatomy and pathology 18,19. The problem with eponyms seems to be that the original description sometimes has been forgotten or replaced by more recent authors, leading to different meanings 1,19-29. We performed an extensive review of the scientific literature to identify the original publication that described the exact structure and pathology of the area of the Kager triangle in order to provide a clear overview of its multiple eponymous structures and diseases (Fig. 1, Table 1).

Fig. 1A: Anatomical structures in and around the Kager triangle. Fig. 1B: eponymous pathologies around Kager triangle.

Achilles Tendon

The Achilles tendon is located on the posterior border of the Kager triangle. The most well-known tendon of the human body was named after Achilles, a hero in the Trojan War and the main character in the Iliad by Homer. In 1693, Philip Verheyen, a Dutch surgeon, was the first to actually name the Achilles tendon after the Greek hero 30. Prior to that time, it was known as the “tendo magnus of Hippocrates.” Only one source recounts the story of Achilles as invulnerable after his mother, holding him by the heel, submerged him in the river Styx in the underworld of Hades 31. Everything the waters touched became invulnerable, but the heel remained dry and unprotected, and
thus remained susceptible to injury. Statius states that Achilles was killed by an arrow that wounded his heel 31, while other authors simply state that Achilles was killed by arrows or a poisoned arrow. Homer even describes Achilles as being wounded in battle, which raises questions about his invulnerability. Interestingly enough, Homer does not describe Achilles’ death.

**Albert Disease**

In 1893, Eduard Albert published an article on achillodynia, which literally means pain at the Achilles tendon. He described a patient who experienced intense pain at the insertion of the Achilles tendon while standing and walking. He described the area of insertion as bulging. Currently, Albert disease is synonymous with retrocalcaneal bursitis 32. Endoscopic treatment for this entity has gained popularity over the last decade 28,33,34. Albert, born on January 20, 1841, was the son of a watchmaker in Žamberk, Kingdom of Bohemia, the Austrian Empire (currently the Czech Republic). He studied medicine at the University of Vienna and received a doctor of medicine degree in 1867. Albert became an operator and assistant under Johann von Dumreicher (1815 to 1880) in the surgical clinic of Vienna. He was appointed full professor at the surgical clinic in Innsbruck in 1873. In 1881, he was appointed to the more prestigious chair of surgery in Vienna, a position he held until 1900. Albert learned of Joseph Lister’s antiseptic procedures and introduced these in Innsbruck, making antiseptics mandatory during the treatment of all wounds. According to Albert, a total revision of surgical practice was necessary to instill these principles. His Lehrbuch der Chirurgie was the first surgical textbook based on the principles of antiseptic treatment. In addition, Albert is remembered for producing “artificial ankyloses” in paralyzed limbs.

<table>
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<tr>
<th>Eponym</th>
<th>Common Noneponymous Term</th>
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<td>Haglund disease</td>
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<td>Haglund syndrome</td>
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<td>Van Dijk hindfoot approach</td>
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<td>Kager triangle/fat pad</td>
<td>Pre-Achilles fat pad</td>
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*Table 1* Overview of eponymous structures and corresponding noneponymous terminology.
He was the first to use the term “arthrodesis,” and he performed tarsal and shoulder arthrodesis for patients with paralysis and recurrent dislocations. After Albert’s death, some of his properties in Zamberk were sold to fund a sanatorium that still carries his name today, the Sanatorium Albertinum.

**Ligament of Rouvière and Canela Lazaro**

In 1932, Rouvière and Canela Lazaro described the fibulotalocalcaneal ligament, also known as the “Rouvière ligament” or the “ligament of Rouvière and Canela Lazaro” (Fig. 2). The Rouvière ligament is an extrinsic sheathlike ligament that occupies the posterolateral corner of the ankle and the posterior aspect of the subtalar joint. It originates from the medial border of the peroneal groove on the posterior border of the lateral malleolus, in common with the origin of the posterior tibiofibular ligament, and frequently reaches the origin of the calcaneofibular ligament. The ligament is known because of its influence on the two-portal posterior ankle arthroscopy (also known as the van Dijk hindfoot approach). Van Dijk describes how the ligament prevents the arthroscopist from...
entering the ankle joint through the posterior portals and advises that the ligament be cut 38. Since cutting the ligament has not been shown to cause any problems 38-40, its exact biomechanical function remains to be determined.

Henri Rouvière, a French anatomist and embryologist, was born in Le Bleymard, (Lozère) France on December 23, 1875. He studied medicine in Montpellier, where he received his doctorate in 1903. In 1910, he became an associate professor of anatomy and embryology at the medical faculty of the University of Paris. He became a full professor of anatomy at the same institute in 1927. Rouvière is well known for the eponymous “node of Rouvière” (the most superior node of the lateral group of retropharyngeal lymph nodes). This node is described in his 1932 publication, Anatomie des Lymphatiques de l’Homme, an extensive study describing and classifying the human lymph nodes and associated drainage regions 41. Rouvière died on October 26, 1952. Many of his anatomical works can be found in the Parisian Musée d’Anatomie Delmas Orfila-Rouvière 42.

Miguel Canela Lázaro was born on September 29, 1894 in the city of Santiago de los Caballeros, Dominican Republic. In 1914, he enrolled at the University of Santo Domingo, where he studied mathematics and engineering. He became a professor of mathematics and natural sciences at the Ecole Normale de Santo Domingo. Probably influenced by his friend, the prominent surgeon Pascasio Salcedense Toribio, he decided to study medicine and received his degree in 1924. He went to Paris to work in the Laboratory of Anatomy at the Faculty of Medicine of the University of Paris (now known as the Paris V, René Descartes University) under the supervision of Henri Rouvière. Together, they investigated the ligaments of the ankle and found a ligament never previously mentioned in the anatomical literature: the fibulotalocalcaneal ligament 43. Later, Canela Lázaro worked with Manoutchehr Hakim and discovered another ligament: the superficial fascicles of the posterior sacroiliac ligament, also known as the Hakim-Canela ligament 44. On December 1, 1977, Canela Lázaro died in Santo Domingo at the age of eighty-three.

**Sever Disease**

Sever disease or Sever injury, also known as calcaneal apophysitis, is a traction epiphysitis of the calcaneus 4. Sever disease is common in active, frequently overweight, children. Boys are more often affected than girls. Symptoms appear around the age of seven to fifteen years in boys and eight to thirteen years in girls. The incidence of Sever disease has been reported to be between 2% and 16% 45-47 of all musculoskeletal injuries, and it is the most common cause of heel pain in the growing child. Children may experience pain over the apophyseal area, which extends up to the insertion of the Achilles tendon, in one or both (in 60% of children with Sever disease 45-47) heels. Despite its prevalence, there is only marginal evidence for any effective treatment of Sever disease, which tends to resolve with skeletal maturity. James Warren Sever, an American orthopaedic surgeon, was born in Kingston, Massachusetts in 1878 and died in 1964 48. He studied medicine at Harvard
Medical School, where he received his degree in 1901. Sever served as an instructor in orthopaedic surgery (1922 to 1929) and an assistant professor of orthopaedic surgery (1929 to 1946) at Harvard Medical School. In addition, he served at Children’s Hospital Boston for forty years and was an associate surgeon at three other hospitals. For more than fifty years, he was the medical director of the Industrial School for Crippled and Deformed Children in Boston. Sever authored several books and scientific articles, and, in 1912, he published a study on “apophysitis of the os calcis” 4,50. This common cause of heel pain in children is now referred to as Sever disease.

**Stieda Process**

The lateral tubercle of the posterior talar process is also known as the “Stieda process.” This posterior talar process consists of a medial and lateral tubercle, separated by a groove in which the flexor hallucis longus tendon runs. The Y-shaped, bifurcate talocalcaneal ligament forms a roof over this groove and inserts onto each tubercle. The posterior talofibular ligament inserts at the lateral tubercle of the talus. When the tubercle is not ossified, it is called an “os trigonum” 51. A prominent posterior talar process, an os trigonum can cause posterior ankle impingement syndrome and can be treated by means of an open or arthroscopic procedure 39,40,52.

Christian Hermann Ludwig Stieda, a German anatomist, was born in Riga (currently Lithuania), on November 19, 1837 53. He received his medical education in Dorpat (currently Estonia), where he won a silver medal in anatomy. After receiving his degree in 1861, he went to Giessen University in Germany, where he studied the anatomy of worms. In 1862, he moved to Vienna, where he studied histology. Stieda was appointed prosector at Dorpat in 1864, and, in the following year, he became a lecturer on comparative anatomy in the veterinary school at the same institute. In 1866, he was elected extraordinary professor of anatomy, and, nine years later, he became a full professor in succession of his teacher Dr. Reissner. He held this chair for ten years, and was Dean of the Medical faculty for the last three years of this period 53. In 1885, he was appointed director of the anatomical institute in Königsberg, where he remained until his retirement in 1912. Stieda died on his birthday in 1918 53. He authored several publications on the history of medicine, archaeology, anthropology, and ethnography. His son, Alexander (1875-1966), became a famous German neurosurgeon.

**Shepherd Fracture**

A Shepherd fracture is a fracture of the lateral tubercle of the posterior process of the talus (the Stieda process). Shepherd noted that the fracture caused no deformity and only vague symptoms 5. The posterior process is susceptible to injury. It is a relatively common fracture in soccer players and ballet dancers, caused by hyperplantar flexion of the foot. A Shepherd fracture can simulate an os trigonum in the eyes of a less experienced radiographic
examiner. Even Dr. Shepherd himself sometimes had trouble differentiating between an os trigonum and a fracture of the lateral tubercle of the posterior talar process 5.

Francis John Shepherd, a Canadian dermatologist, anatomist, and surgeon was born in Como, Quebec in 1851 and died in 1929. He graduated from McGill University in 1873. During his student days at McGill, Shepherd developed a friendship with William Osler, who he described as “a keen-eyed alert, spare young man with an enormous amount of energy” 54. After obtaining his degree at McGill in 1872, Osler subsequently became a staff member there. He wrote to Shepherd, suggesting that he apply for the position of demonstrator of anatomy at McGill, and Shepherd returned to the university in 1875. He became a full Professor of Anatomy in 1883 and remained so until 1913. He also served as Professor of Dermatology from 1908 to 1913 and Dean of the Faculty of Medicine from 1908 to 1914, retiring as Emeritus Dean and Professor in 1919. In 1882, Shepherd published “A Hitherto Undescribed Fracture of the Astragalus,” 5 a descriptive study of several dissecting room specimens: “the part fractured was the little process of bone external to the groove for the tendon of the flexor hallucis longus” 5. His findings gave rise to a long-lasting discussion. Well-known anatomists entered the discussion on the origin of the Shepherd fracture: was it a fracture or a separate ossicle? The idea that this fragment of bone was an ossicle was first described by Gruber and Stieda in the 1880’s. Von Bardeleben termed the ossicle an “os trigonum”. Shortly after Shepherd’s publication, Professor Bennett stated it was an ossicle, not a fracture fragment 55. Shepherd reacted after additional observations: “further investigation of the subject has led me to reject the theory that the ossicle, found at the posterior border of the astragalus, is due to fracture; I am now convinced that it is an un-united epiphysis, and has an origin from a separate centre of ossification” 54,55. To this day the discussion remains as to whether the fragment of bone is a Shepherd fracture or an os trigonum.

Haglund Deformity, Syndrome, and Disease

Dr. Patrik Haglund was not the first to report on bursitis of the retrocalcaneal bursa or its treatment 26,56. He differentiated between several types of bursitis of the posterior calcaneal region and reported on the successful surgical treatment of retrocalcaneal bursitis2. To our knowledge, it was in 1958 that retrocalcaneal bursitis was first termed “Haglund disease” 57. Currently, “Haglund deformity” is defined as a posterosuperior calcaneal prominence or exostosis. Because the retrocalcaneal bursa may impinge between the deformity and the Achilles tendon, it can cause a retrocalcaneal bursitis. Because “Haglund syndrome” is the term for many different combinations of pathology, it can cause confusion. It is frequently described as a combination of an insertional Achilles tendinopathy, a retrocalcaneal bursitis, a superficial bursitis, and a posterosuperior calcaneal exostosis. Because of these different interpretations, it was recently proposed to not use the term “Haglund” to describe pathologies involving the posterior part of the calcaneus16. Like-
wise, the term “Haglund disease,” which is sometimes known as osteochondrosis of the accessory navicular bone (or os tibiale externum) 22,27,58, has caused confusion. As a result, it has also been proposed to not use the term “Haglund disease” in clinical practice 16.

Haglund was born the son of a doctor in Norrköbing, Sweden on May 27, 1870. After studying physics and astronomy for three years in Uppsala, he started studying medicine in 1891 and received a degree in 1899. He learned the principles of orthopaedic surgery mainly in Germany. At the time, this area of expertise was still underdeveloped. Like nearly all of his teachers, Haglund was mostly autodidactic. His thesis was called “Radiographic Studies of the Functional Structure of Spongious Bone in the Calcaneus.” During his career, he published as many as 300 manuscripts and books. The two main publications were Consequences of Paralysis in Children and Treatment” (1913) and Principles of Orthopedics (1923). Because Haglund was the only professor in orthopaedics in Scandinavia, he became a very important figure. In 1930, he founded Acta Orthopaedica Scandinavica. On December 8, 1937, Haglund died of a heart attack, which had been mistaken for a backache. When an injection was prepared for him, he supposedly said, “inte skall man ha spruta för rheumatism i ryggen” (because of rheumatism in the back, you don’t need an injection) 59.

Kager Triangle/Fat Pad
The Kager triangle or Kager fat pad is also known as the pre-Achilles fat pad. It is a lipomatous triangular structure bounded by the flexor hallucis longus muscle and tendon anteriorly, the superior cortex of the calcaneus inferiorly, and the Achilles tendon posteriorly8. The retrocalcaneal bursa forms the posteroinferior corner of the pad. With an Achilles tendon rupture, the triangle may appear deformed on a conventional lateral radiograph.

Dr. Hans Kager has a history that is hard to elucidate. Besides his principal work (1939) on the treatment of Achilles tendon rupture 7, we did not find any other publications of his. From the original publication, we can derive that, at the time, he was working at the Hohenlychen Sanatorium in Lychen, Germany. Karl Gebhardt, the Nazi doctor and personal physician of Heinrich Himmler, who stood trial at the Nuremberg Doctors’ Trial and was sentenced to death for war crimes and crimes against humanity, was the head of Dr. Kager’s department. To our knowledge, there is no additional information on Dr. Kager’s personal life, his work, or his political affinities. In his original publication, Kager mentions the triangle. The first time we found it cited as the term “Kager triangle” was in a 1977 German publication 60.
Eponyms of the Kager triangle

DISCUSSION

This report provides an overview of eponymous structures, pathological approaches, and tests in the area of the Kager triangle. The question remains whether eponyms are a gift or a curse in daily medical practice. As described earlier, the benefits are obvious: eponyms are a tribute to the founder of the structure or disease 10,61. In addition, eponyms are unaffected by language barriers. This is in contrast to many medical definitions (e.g., calcaneus or calcaneum). Indeed, the international recognition of a term may be the main advantage of eponymous annotations over anatomic nomenclature. Additionally, it may be considered a tradition to name a discovery after its founder 10,61.

However, there are several disadvantages with the use of eponyms 9,19. The accidental use, or worse, the intentional misuse or incorrect use of eponyms, is important to note62. For example, the well-known Thompson test for Achilles tendon ruptures was wrongly named after Dr. Theodore Campbell Thompson. The discoverer of this test was in fact Dr. Franklin Adin Simmonds 63. The calf squeeze test is commonly referred to as the Thompson test, or the Thompson-Simmonds test, rather than the Simmonds test 63,64. The fact that eponyms are traditionally seen as a tribute to the founder makes them inevitably susceptible to misuse11. Whether or not everybody is justified in receiving such a tribute has been an issue of discussion, specifically in regard to the discoveries made by Nazi doctors 14,65-70. There has been a long-lasting debate whether or not unethical discoveries should be honored by any means, and whether they should be removed from the history books altogether 14,65-67,71.

Finally, the use of eponyms is also susceptible to accidental erroneous use, which can create overall confusion regarding a certain topic or entity (e.g., as discussed previously with the Haglund eponym) 13,16,18. Some believe that daily medical practice would be less confusing if use of eponymous nomenclature is discontinued and replaced with a uniform terminology based on a combination of anatomic location, symptoms, clinical findings, and/or histopathology 13,16,18,19 (Table 1).

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31. Statius PP. Achilleis. c. 94-96 CE.