

# Result of Human-induced Hybridization--Cat Born with Genetic Defect

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**Abstract.** Advancements in genetic science have facilitated the creation of popular cat breeds like the Scottish Fold and Munchkin, often admired for their distinct physical features and affable personalities. While these innovations mark a significant stride in the domain of genetic manipulation, they are not devoid of controversy, often giving rise to pressing ethical concerns. This arises primarily due to the potential health issues that such breeds might inadvertently inherit, coupled with diminished survival skills should they find themselves in the wild. Moreover, this pursuit of desired traits sometimes overshadows the imperative of ensuring robust animal welfare standards. As humanity delves deeper into the realms of genetic science, striking a harmonious balance between technological progression and safeguarding the intrinsic rights and well-being of these animals becomes increasingly pivotal. This underscores the compelling need for ethical responsibility in steering genetic advancements, fostering a future where technology serves as a boon rather than a bane in the evolutionary narrative of these beloved feline companions.

**Keywords:** Breeding, genetics, defect.

## 1. Introduction

### 1.1. Background Information

In the ever-evolving field of genetics, our capacity to manipulate the genetic composition of animals, including domestic cats, presents both opportunities and ethical dilemmas. Notably, specific popular cat breeds like the Scottish Fold and the Munchkin have emerged through extensive human intervention and selective breeding practices designed to cultivate distinct genetic traits catering to human preferences. However, these interventions have occasionally resulted in unintended consequences, such as birth defects and health issues, prompting ethical questions regarding the extent of human interference in the natural genetic progression of these animals. Despite these concerns, it is important to recognize that many of these hybridizations have yielded favorable results, with these cats often exhibiting personality traits more in line with what people desire in a pet. Generally, these breeds tend to be more affectionate, sociable, and less aggressive than their wild counterparts, characteristics highly valued by pet owners. This domestication, a result of genetic manipulation and selective breeding, has led to a noticeable reduction in their wild, aggressive behaviors. However, this tameness may come at a cost, as these breeds may possess diminished survival instincts and abilities, rendering them highly vulnerable if left to fend for themselves in the wild. This vulnerability underscores the dual nature of genetic manipulation: while it empowers us to create animals aligned with our preferences, it also necessitates careful consideration of the potential consequences for their well-being and survival. Therefore, as we continue to explore the frontiers of genetic manipulation, maintaining a steadfast commitment to ethical considerations is imperative to safeguard the welfare and well-being of these animals, ensuring that they are not compromised for human desires. Balancing technological advancement with ethical responsibility presents an ongoing and significant challenge in the quest to responsibly harness the potential of genetic science.

### 1.2. Industry Research Current Status

The domain of genetic manipulation within pet breeding is presently undergoing rapid transformation. Breeders and geneticists are increasingly utilizing advanced techniques to create diverse cat breeds tailored to a wide array of human preferences. This burgeoning industry has ignited

extensive discussions spanning animal welfare, ethics, scientific advancements, and responsible breeding practices. Regulatory bodies have also begun to establish more rigorous guidelines to ensure ethical conduct and sustainability within the realm of pet breeding.

### 1.3. Motivation and Research Framework

Motivated by the multifaceted dynamics outlined above, this study aims to delve deeper into the ethical and practical dimensions of genetic manipulation in pet breeding. Our research framework encompasses the following components: the paper will delve into the ethical dilemmas surrounding pet breeding, examining the moral responsibilities involved, addressing animal welfare concerns, and assessing the inadvertent introduction of genetic defects. A comprehensive analysis of current pet breeding practices will be conducted, encompassing breeding methodologies, objectives, and the existing regulatory landscape to gain insights into ongoing trends and challenges. Research will explore strategies to ensure the sustainable practice of pet breeding while balancing human desires with animal needs. This will include promoting responsible breeding and educating breeders and pet owners. Future Perspectives: Lastly, we will discuss potential future directions for the pet breeding industry, including the formulation of ethical guidelines, advancements in genetic technologies, and the significance of public education in fostering responsible practices.

## 2. Animal Science: Cat Breeds

### 2.1. Scottish Fold Cats: Beauty and the Burden of Genetic Imperfections

The Scottish Fold cat, a unique breed with over a century-long history, is widely adored for its endearing folded ears that lie close to its forehead and its gentle temperament. However, the breed is not without its imperfections; it is almost universally affected by a congenital genetic defect. These cats are predisposed to a dominant form of osteochondrodysplasia right from birth. The gene causing the ear fold, known as *Fd*, is incompletely dominant. Cats with a single copy (*Fd/fd*) exhibit the characteristic folded ears, while those with two copies (*Fd/Fd*) often manifest severe skeletal abnormalities. Even those with just one copy can experience limb stiffness and symptoms similar to arthritis, especially when they are homozygous for the gene. More alarmingly, a dominant variant of the *TRPV4* gene is the underlying cause of this developmental disorder. This mutation leads to a shortening of the bone and joint spaces in Scottish Folds, causing them to experience generalized pain. In a recent study, both Scottish Fold cats investigated were found to be heterozygous for a missense mutation located at exon 6 (c.1024G>T), while none of the three straight-eared cats displayed this mutation[1]. This provides further evidence that, in comparison with other breeds, the dominant genes of Scottish Folds come with inherent flaws.

This article enters into an in-depth analysis of a specific case. A 2-year-old female neutered Scottish Fold cat presented with progressive gait abnormalities in both hindlimbs [2]. At just two years old, an age that should symbolize the height of youth and vitality in a feline life, this cat found herself beleaguered by osteochondrodysplasia—a debilitating condition far removed from what one would expect at such a young age. In this particular case, veterinarians found themselves in the unenviable position of having to excise areas where the cartilage had hypertrophied, relying on endoscopic methods for diagnosis. Drawing a human parallel, it's akin to a young, robust individual facing relentless physical and emotional torment due to a dominant genetic flaw. And who is to blame for this cascade of misfortunes? The unsettling answer lies in the reckless manipulation of animal genetics to satisfy human whims and desires.

In comparison to the congenital diseases that afflict Scottish Fold cats, there are also brighter aspects that characterize this unique breed. For instance, a study entitled "Examination of Shape Variation of the Skull in British Shorthair, Scottish Fold, and Van Cats" sheds light on some of these positive features[3]. In this research, scientists examined the skulls of three feline breeds: the British Shorthair, the Scottish Fold, and Van cats. The data revealed that Scottish Folds possess the broadest orbital margins among these breeds. This expanded eye socket boundary bestows upon the Scottish

Fold a particularly endearing and sweet appearance that is universally appealing. This facet of their anatomy contributes to the breed's allure, offering a delightful counterpoint to the serious health concerns they also inherently carry. Such a feature, beyond just aesthetic appeal, enriches our understanding of the Scottish Fold cats and adds a nuanced layer to the complex portrait of this enigmatic breed.

Beneath the alluring appearance of Scottish Fold cats lies a genetic predisposition to lifelong suffering from various ailments. As such, these cats are not an ideal choice for casual pet owners. Due to dominant genetic issues, Scottish Folds are susceptible to a range of cartilage and skeletal disorders, including osteophytes, exostoses, ankylosis, and progressive osteoarthritis[4]. These congenital conditions are extremely challenging to treat. Upon adopting a Scottish Fold, owners must come to terms with the animal's medical complexities, which often manifest as lethargy, decreased appetite, and can incur steep veterinary costs. Given these hurdles, individuals who are not fully committed or those lacking a strong sense of responsibility may opt to abandon these already suffering cats. Stranded in unfamiliar environments and faced with constant pain, the grim fate that awaits these abandoned animals is often a tragic death. So, while their unique appearance may be initially captivating, the ethical and financial commitments required to adequately care for Scottish Folds should not be underestimated. Potential owners must be aware of the significant responsibilities involved, lest they contribute to the growing issue of abandonment and suffering for these beautiful yet fragile creatures.

## **2.2. Munchkin Cats: Adorable Charm, Health Challenges, and Genetic Abnormalities**

A breed of cat known as Munchkin or Sausage Cat is distinguished by unusually small legs that result from a genetic abnormality. Munchkins are little cats with various health problems like any other breed, but they usually have a 12- to 15-year lifespan. Munchkins are often susceptible to pancreatitis, urinary tract infections, and cardiac issues afflicting most feline breeds. Munchkins are little, but they have enormous personalities, retain their kitten-like traits into maturity, and are very trainable. A Munchkin's back slopes slightly downward because his rear legs are somewhat longer than his front legs, which causes his front legs to bend slightly. The colors, patterns, and coat lengths of munchkins are endless. They get along well with kids and other pets, making them wonderful family pets. They are also highly gregarious and affectionate cats. Cats show their devotion to one another and other cat family members by grooming one another [5]. They may extend this to people by licking their faces and bodies like fur. It's the ultimate sign of love and a means for cats to mix odors.

The first strength that makes these cats strong is their charm and attraction. Munchkin cats are renowned for their cute look, and many cat lovers find them charming due to their small legs and unusual attitude. You'll be able to immediately identify Munchkin cats because of their short, small legs and cute, expressive features. They are affectionately called "Sausage Cats" and are distinguished by having shorter legs that resemble those of a Corgi or Dachshund. Little though they may be, these cats are powerful. The second strength is that Munchkin cats are often characterized as lively and energetic. Despite having shorter legs, they can nonetheless do common cat behaviors like leaping and climbing. The Munchkin is an inquisitive, perceptive, amiable, and lively feline with many traits with other domestic cats. While it may be fonder of cuddles and stroking than other cats, it is also eager to practice its hunting instincts by pursuing and catching toys when given the chance. Last but not least, Munchkin cats are adaptable to various living situations, including homes and flats.

Regarding vulnerabilities, Munchkin cats' distinct body form might make them more vulnerable to certain health problems, such as dental and joint difficulties and spinal disorders. The defining characteristic of the Munchkin cat breed is its shorter limbs, which result from a genetic abnormality that affects cartilage development. A genetic abnormality has caused their legs to become shorter, which may lead to skeletal deformities. Second, compared to cats with typical leg lengths, their agility may be restricted due to their small legs. Munchkin cats have trouble pursuing toys or scaling tall things[6]. Lastly, since a genetic abnormality that gives rise to the breed's distinctive characteristics

might have negative health effects, some animal welfare proponents are wary about reproducing Munchkin cats. Munchkin cats' leg bones are malformed due to an undesirable genetic abnormality that prevents normal growth. Their consequent small legs impact these felines' behavior, and they may be more susceptible to excruciating osteoarthritis.

Achondroplasia, a dwarfism, is the most common genetic abnormality seen in Munchkin cats. This syndrome is frequently called faux achondroplasia because, according to a study, the Munchkin cat does not exhibit all the features present in certain cats with dwarfism [7]. This genetic defect causes short legs by altering the growth of the long bones. This characteristic gives Munchkin cats their distinctive look, but it also makes their legs abnormally small, which may cause problems for their spine, ribs, and other bones. Numerous dwarf cat breeds have been formed by outcrossing the Munchkin with a wide range of standard-sized feline species. While there is minimal study on this topic, anecdotal accounts suggest that Munchkin cats may be more susceptible to cardiac issues[8]. Dwarfism is a genetic disorder that causes abnormally small height due to skeletal dysplasia. This indicates an asymmetry between the limbs and the trunk compared to a person of typical height. While genetic abnormalities account for the vast majority of cases of dwarfism, the origins of certain cases remain a mystery. Most cases of dwarfism are caused by a chance mutation in either the father's sperm or the mother's egg rather than being the consequence of a defect in one or both of the parent's genes.

### **2.3. Ragdoll Cats: Gentle Giants with Endearing Personalities and Health Considerations**

The Ragdoll cat has a blue eye coloration and a characteristic colorpoint coat. It has a semi-long, luxurious coat and a huge, heavy build. Ragdolls were created in the 1960s by American breeder Ann Baker, and they are noted for their calm demeanor and loveable personalities [9]. The moniker "ragdoll" stems from the fact that these creatures often collapse when picked up. These cats have a clever, kind, and very loving demeanor, and they like being held and babied. It's because they give off an air of laziness while they're spread out on the sofa. They may not be as agile as your other cats, but behind that beautiful fur is a strong musculature.

Ragdoll cats are known for being calm and friendly, and many people find them to be a wonderful addition to their homes because of these qualities. The Ragdoll cat has a reputation for being one of the most chill housecat varieties. These felines have a low base happiness threshold and may easily adapt to new environments. According to studies, Ragdoll cats are very calm and mellow and make faithful and devoted companions [10]. The cats' size and the quality of their fur and eyes are two of their greatest assets. Ragdolls are more expensive than other cats because of their numerous endearing qualities. In a perfect world, they would only be bred by professionals with extensive breed knowledge. Cats have a lot of admirers due in large part to their remarkable looks. Lastly, unlike other longhaired breeds, Ragdolls seldom have matting difficulties and need less maintenance despite their long fur. Grooming a cat regularly may help maintain its skin's health by removing dust, debris, fleas, and other parasites from its hair. Because brushing increases blood flow, natural oils are distributed more uniformly throughout the coat, making it seem healthier and glossier.

Ragdoll cats, like other breeds, have a propensity for some hereditary health problems, such as hypertrophic cardiomyopathy, renal disease, and hip dysplasia. Left ventricular hypertrophy is a disease that affects the heart's primary pumping chamber[11]. The left ventricle's walls grow thick and rigid. With time, the heart loses its ability to adequately meet the body's demands by either receiving or pumping out enough blood with each beat. Two copies of the disease-causing gene greatly increase the possibility of severe HCM symptoms in a Ragdoll cat, typically between the ages of 1 and 2, and the risk of sudden cardiac death. Cats with a single copy of the mutation may have normal lives and exhibit no symptoms. The second flaw is that Ragdolls are a big breed, which might cause problems in tiny apartments. Last but not least, they are known to develop tension and anxiety if left alone for too long without their human companions.

Like many other cat breeds, Ragdoll cats are typically healthy except for the possibility of hereditary abnormalities such as chronic renal disease. Several breeder websites state that polycystic kidney disease and chronic interstitial nephritis are major causes of chronic kidney disease in

Ragdolls. Medication, surgery, or a hybrid of the two may be used to treat various forms of renal disease. Urinary tract obstruction is the leading cause of acute kidney failure, making removing the stone an emergency. A more conservative strategy, such as intravenous fluid treatment and dietary modifications, may be used to manage chronic renal failure. Studies have shown that renal illness may result in serious side effects such as high blood pressure, cardiac issues, and even death[12]. Kidney disease is treatable; therefore, it's crucial to be tested often and obtain help if symptoms appear. The key to early identification and effective treatment is consistent monitoring of kidney function. Hip dysplasia is a developmental disease that affects the hip joint and may cause movement difficulties and pain in certain Ragdolls.

### 3. Conclusion

With further in-depth research into advanced genetic techniques and complex crossbreeding technologies, the ability of humans to manipulate and modify the basic characteristics of various cat breeds, including Scottish Folds, Munchkins and Ragdolls, has been dramatically improved, and it is like a miraculous skill. These scientific advancements allow us to fine-tune attributes ranging from temperaments and physical sizes to innate instincts, crafting feline companions that align more closely with desires and aesthetic preferences. However, in the midst of these advancements, an ethical dilemma has surfaced. As epitomized by the Scottish Fold, Munchkin, and Ragdoll breeds, intervention has not only brought forth visually appealing and temperamentally affable feline companions but also ushered in a surge of health complications, ranging from debilitating skeletal deformities to life-threatening heart and renal diseases. The Scottish Fold, for instance, is susceptible to painful degenerative joint diseases, while the Munchkin breed's hallmark short legs, a result of genetic mutation, can lead to spine and other bone problems. Meanwhile, the Ragdoll cat, adored for its serene disposition, faces potential hereditary ailments like hypertrophic cardiomyopathy and chronic renal disease, underscoring the detrimental implications of unchecked breeding practices. Thus, echoing the wise caution that "With great power comes great responsibility", it becomes solemn duty to wield newfound capabilities with utmost restraint and respect for the sanctity of life. The journey to create the 'perfect' pet should not eclipse the moral obligation we hold to ensure the wellbeing and health of these beloved creatures. Therefore, when standing at the forefront of a new era in animal breeding, it is essential to foster a culture that not only values the uniqueness of these breeds, but also promotes responsible breeding practices that prioritize the welfare and longevity of these animals and affirms the commitment to valuing and respecting each individual life.

### Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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