

Mirror-Image Identical Twins Presenting in Mirror-Image Hip Cysts: A Case Report and Review of the Literature

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Abstract

One-third of twins are monozygotic. Of monozygotic twins, 25% of them are mirror images. Mirror-imaging occurs when pathologic conditions are present on opposite sides of the body. This is the first case report of mirror-image identical twins with opposite hip pain that were found to have small cysts of the femoral head on opposite hips.

Case presentation: 38 year-old mirror-image Asian female identical twins presented with hip pain on opposite sides. MRI demonstrated a 4 mm cyst of the anterior aspect of the left hip, the femoral head and neck junction, with a herniation pit on opposite sides. The right-handed twin had the cyst on the right hip, and the left-handed twin had the cyst on the left hip.

Conclusion: Mirror-image pathology in mirror-image monozygotic twins suggests possible cytogenetic factors involved in the etiology of various medical problems. If an identical twin presents with a medical problem, it may be recommended to perform a medical diagnostic work-up on the other twin.

Keywords: Identical twins; Mirror-imaging; Bone cyst

Introduction

Twin studies historically have aided in understanding how genetic and environmental factors affect various pathologies [1,2]. Mirror-image pathology in mirror-image monozygotic twins suggests possible cytogenetic factors involved in the etiology of various medical problems. This is the first case report of mirror-image identical twins with opposite hip pain who were found to have small cysts of the femoral head on opposite hips.

Case presentation

38 year-old mirror-image Asian female identical twins presented with hip pain on opposite sides 3 weeks apart. The pain occurred randomly without diurnal variation or specific pattern. The patients were a product of a full-term spontaneous vaginal delivery to non-consanguineous parents 3 minutes apart. Their birth weights were 5 lbs, 3 oz and 5 lbs 6 oz, respectively. Their past medical histories were negative. As children, they were very athletic and flexible, both involved in the swimming team and gymnastics. They denied any trauma.

The hip pain presented in the left-handed twin first, described as sharp, shooting pain in the left, dominant hip, that was transient and of sudden onset. The right-handed twin presented 3 weeks later with transient, shooting pain of the right hip. Both twins wore orthodontic braces at age 15 years due to cross-bites that was in opposite directions. Their dentition was almost identical, with mirror-image lateral incisors (Figures 1A-1H). They had allergies to sulfa. At an early age, it was noted that the first twin was left-handed, and the second twin was right-handed.

MRI of the hip demonstrated a 4 mm cyst of the anterior aspect of the left hip, the femoral head and neck junction, characteristic for a herniation pit on opposite sides. The right-handed twin had the cyst on the right hip (Figures 2A-2D), and the left-handed twin had the cyst on the left hip (Figures 3A and 3B). Alpha angles (Figures 3C) were attempted but could not be measured since there was no MR evidence of Femoroacetabular Impingement (FAI). The femoral heads on both patients were spherical without evidence of a dysmorphic bump of the anterior femoral head-neck junction to suggest FAI.

Normal acetabular anteversion (Figures 3C and 3D) was seen of both patients ranging from approximately 20 to 23 degrees (mean acetabular anteversion is 23 degrees with a range of 12-39 degrees).

Due to remission of their symptoms with oral non-steroidal anti-inflammatory agents, both twins chose to undergo observation.

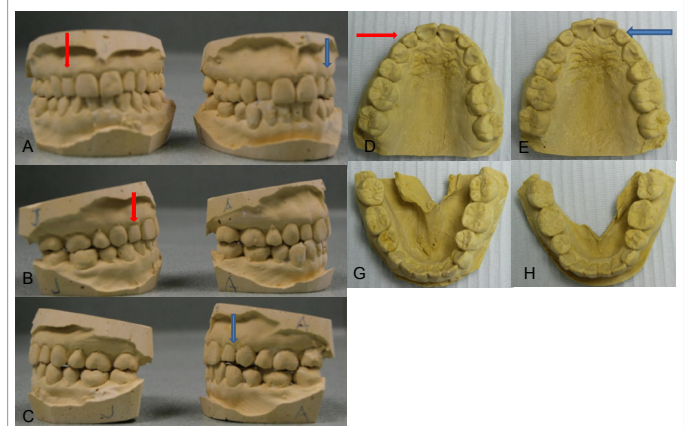


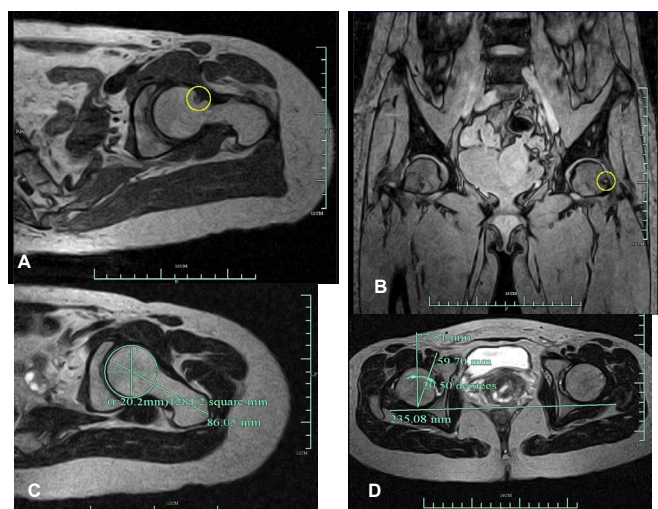
Figure 1: Both twins underwent orthodontic work for cross-bites that were in opposite directions. The molars were tipped and rotated identically. **A, B, D:** The right-handed twin's right lateral incisor (red arrow) was larger than her left lateral incisor. **A, C, E:** The left-handed twin's left lateral incisor (blue arrow) was larger than her right. **G, H:** The lower teeth appear to be almost identical.

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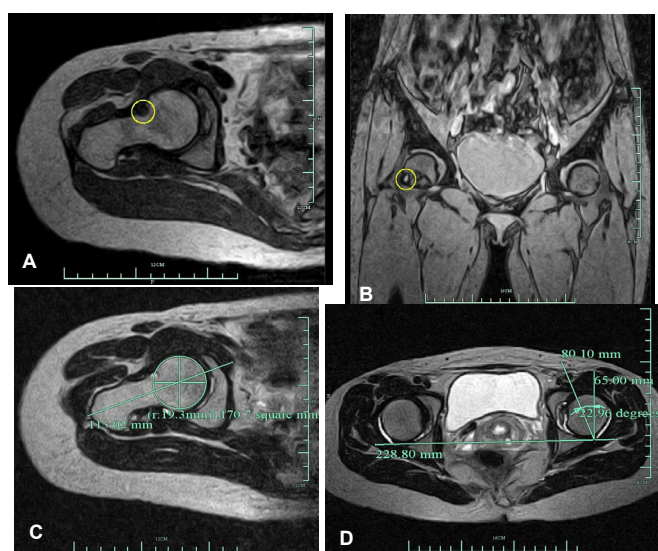
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Figures 2: A, B: The left-handed twin had a left hip cyst. **C:** Acetabular angle measurement was attempted. **D:** There is normal acetabular anteversion.



Figures 3: A, B: The right-handed twin had a right hip cyst. **C:** Acetabular angle measurement was attempted. **D:** There is normal acetabular anteversion.

Discussion

Monozygotic twinning occurs in all ethnic and racial groups [1]. Monozygotic twins can be divided into dichorionic/diamniotic, dichorionic/monoamniotic, or monochorionic/monoamniotic. If the split occurs prior to the formation of 2 cell lines, the result is dichorionic/diamniotic twins. If the embryo divides at the blastocyst stage (after differentiation and formation of the inner-cell mass and trophoctoderm), the result is a dichorionic/monoamniotic twin; this is the most common form. If embryo splitting is later (after the ectoplacental cone has formed), the fetus shares both the amion and chorion (monochorionic/monoamniotic twinning), which is the least common. There has been an increase in the number of monozygotic pregnancies, implying that some event *in vitro* may be partially responsible for the monozygotic twinning phenomenon.

Other species have demonstrated twinning as well. The nine-banded

armadillo and the Rhesus monkey exhibit splitting of the epiblast plate into mutiple embryonic shields, to allow maximum fecundity of their species during breeding season. There may be an evolutionary benefit to the twinning phenomenon.

Axis, polarity, and right-left asymmetry are part of normal development of the embryo and fetus in mammals. It is hypothesized that monozygotic twinning is associated with a disruption of normal axis formation, resulting in a duplication event.

Right -left asymmetry occurs early on, during gastrulation. Mirroring occurs when the zygote splits after one week after conception [2]. The mechanism of mirroring phenomenon not only applies to physical conditions but to psychiatric conditions as well as sleep disorders [3]. Mirroring can be classified as anatomic, functional, medical, or psychological. The mirroring phenomenon is a reflection of a biological polarization. Biological polarization in this context is a descriptive term emphasizing the role of biological (physiological, biochemical or even genetic) versus psychological or environmental factors causing not only mirror body image but opposite tendencies in the development of personality, professional and sex orientation and the opposite presentation of pathology. This may aid in the study of pathologic conditions, such as heterotaxy syndrome, study by Badzakova-Trajkov et al. [4] suggests that mirror-imaging is highly due to chance. The study involved MRIs on 42 pairs of monozygotic twins found that although genetic influence plays a large role in handedness and cerebral dominance, there was little influence on spatial judgment or face processing, implying that mirror-imaging in monozygotic twins was highly due to chance.

Townsend et al. [5] has implied that twin studies can elucidate how genetics and environment can affect dentition (number of teeth and shape of teeth). Correlation coefficients were significantly higher in MZ than in DZ twins, suggesting a high genetic influence [6]. Discordancy for dentition, such as hypodontia, has been reported [7,8]. There are reports of twins' having mirror-image supplementary incisor teeth [9] and premolar dysplasia [10]. Our patients had dental cross-bites that were identical but mirror images. Both received orthodontic treatment at age 15 years for their cross-bites, which may account for some of their dentition similarities; however, their childhood dentist had commented on their identical teeth at age 7 years, prior to any orthodontic work. Unfortunately, dental radiographs from childhood could not be obtained.

The mirror-imaging phenomenon has occurred in other orthopedic conditions, such as bone cysts of the humerus [11] and trigger thumbs [12]. The twins with trigger thumbs presented asynchronously (one at 11 months and one at 18 months), suggesting both a congenital and acquired etiology. There had been no case reports of atrigger thumb affecting just one twin.

Other organ systems besides, such as the eye, have reports of mirror-imaging: anisometropia, [13-15], exotropia, [16] and optic nerve dysplasia [17]. Microtia occurring in mirror-image twins has also been reported [18]. Pathologic mirror-imaging has been reported in intracranial conditions like arachnoid cysts [19,20].

In monozygotic twins, there is always a risk of conjoined twins, such as ischiophagus [20]. This mechanism involves fission more likely than fusion [21]. In their case study of stillborn thoracopagus twins (in which the chest wall and upper thorax are attached), cleft palates and lips were also present. Their hypothesis for the formation of cleft palates and lips was that there was a problem in the distribution of blood vessels that interferes with the formation and normal development of

facial structures. The authors hypothesize that circulatory problems may be key contributors to cleft lip and palate. Cleft palate and lips occurs more on the left side of the face due to the greater blood supply on the right side of the face during embryogenesis. The thoracopagic twins were facing each other, so that their opposite sides were exposed to the weaker blood supply. Mirror-image cleft lip and palate has been associated with other pathologic conditions, including anencephaly [22] and branchial arch syndrome [23].

Heterotaxy, or situs inversus, occurs when the organ systems are on the opposite side. This has been reported in the chest, [24,25] in which mirror-image twins had chest tumors on the opposite sides, as well as in urologic situations [26,27] (in which mirror-image monozygotic twins simultaneously present with posterior urethral valves on opposite sides with respective hydronephrosis, necessitating reimplantation of the ureter into the bladder diverticulum for both twins). Situs inversus has also been reported in the heart [28]. In this situation, the identical twins were diagnosed with situs inversus at age 20 years, but later in life (38 and 43 years) presented with hypertrophic cardiomyopathy 5 years apart. Situ inversus has been reported has been reported to also occur with asplenia; [29] they had almost identical mirror-image abdominal thoracic viscera. It has also been reported with vertebral anomalies [30].

Situs inversus can be discordant, in which case it is termed situs inversus specularis, in which only one person of a twin set has the condition.

Although physical characteristics can be concordant, mirror-image monozygotic twins can exhibit discordance with psychiatric conditions. Lohr and Bracha [31] reported one twin who was diagnosed with bipolar disorder, while the other had schizophrenia. Facial and dermatoglyphic analysis revealed mirror-image smiles as well as fingerprint patterns. Dermatoglyphics can be affected by second-trimester prenatal infections, such as rubella and cytomegalovirus.

Our case is similar to others in that the twins presented at around the same time with physical ailments. This is the first report of twins presenting with hip pits. This report is limited because there is only one set of patients. However, the fact that they had mirror-image crossbites in their dentition suggests that multiple organ systems can be affected, as evidence by other reports.

Herniation pits [32,33] are characteristically located in the proximal anterior superior quadrant of the femoral neck. Typically, the lesion is round or oval and usually less than 1 cm. Pits may increase in size with time. Causes include hyperextension, which our subjects did report. These cysts may or may not be related to our patients' pain, as herniation pits can be symptomatic in some patients. There was no radiologic evidence of FAI or other pathologic hip conditions.

Conclusion

Mirror-image pathology in mirror-image monozygotic twins suggests possible cytogenetic factors involved in the etiology of various medical problems and can help elucidate the mechanism of pathologic conditions, such as cleft palates and lips. Frequently, there is concordance for medical conditions in identical twins. If an identical twin presents with a medical problem, it may be recommended to perform a medical diagnostic work-up on the other twin.

Consent

Written informed consent was obtained from the parents of our patients for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing Interest

The authors declare that they do not have competing interests.

Authors' Contributions

All authors read and approved the final manuscript.

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