

# Normal Biliary Confluence Angle In Classical Junction Type: Assessment With MR Cholangiopancreatography

Normal Biliyer Konfluens Açısının MR Kolanjiopankreatografi ile Değerlendirilmesi

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MR kolanjiopankreatografi (MRKP) görüntüleri üzerinden ortalama biliyer konfluens açısını hesaplayarak bu açı ile yaş, cins ve vücut kitle indeksi arasındaki olası ilişkiyi araştırmak amaçlanmıştır.

**Gereç ve Yöntem:** Mayıs 2006 ile Aralık 2006 tarihleri arasında karaciğer fonksiyon testlerinde bozukluk ya da safra kanallarında patoloji şüphesi başta olmak üzere çeşitli endikasyonlarla MRKP yapılan toplam 40 hasta (18 kadın, 22 erkek, yaş aralığı 22-86 yaş) çalışmaya dahil edildi. Hastaların hiçbirinde geçirilmiş karaciğer ameliyatı öyküsü ve biliyer konfluens düzeyinde yer kaplayan lezyon yoktu. Safra kanalı varyasyonu olanlar ve bilinen safra yolu ya da kronik karaciğer parankim hastalığı tanısı olanlar çalışma dışı bırakıldı. Biliyer konfluens açısı iki radyolog tarafından koronal oblik planda alınan üç ardışık kalın kesit MRKP görüntüsü üzerinden ve açının en geniş olduğu düzeylerden ayrı ayrı ölçülerek her araştırmacı için ortalama değerler kaydedildi.

**Sonuçlar:** İstatistiksel olarak iki araştırmacı arasında yüksek uyum mevcuttu ( $p < 0.001$ , intraclass correlation coefficient = 0.93). Birinci araştırmacı için hesaplanan ortalama açı  $87.87 \pm 22.92^\circ$  (aralık  $51-155^\circ$ ) iken ikinci araştırmacı için ortalama açı  $85.40 \pm 25.80^\circ$  (aralık  $45-166^\circ$ ) idi. Biliyer konfluens açısı ile yaş, cins ya da vücut kitle indeksi arasında istatistiksel olarak anlamlı bir ilişki bulunmadı. Birinci araştırmacı için ortalama açının %95 güven aralığı üst ve alt sınırları  $80.54-95.20^\circ$  iken, ikinci araştırmacı için  $77.14-93.65^\circ$  idi.

**Sonuç:** İstatistiksel olarak normal biliyer konfluens açısının yaş, cins ve vücut kitle indeksinden bağımsız olduğu ortaya konmuştur.

**Anahtar Sözcükler:** *Safra Yolları, Kolanjiopankreatografi, Safra Kanalları*

We aimed to determine the mean biliary confluence angle on MR cholangiopancreatography (MRCP) images and investigated the variability of the angle by age, gender, and body mass index.

**Material and Methods:** The study population was drawn from the patients referred to MRCP between May 2006 and December 2006 for various indications; the most being for abnormal liver function tests or suspected biliary disease. A total of 40 patients (18 women and 22 men, age range 22-86 years) who denied a history of prior liver surgery, and in whom MRCP excluded bile duct variations, biliary diseases or chronic parenchymal liver disease were enrolled. The confluence angle was measured independently by 2 observers on 3 successive coronal oblique thick-collimation images where the angle is widest and the mean values were noted for each observer.

**Results:** Statistically there was almost perfect agreement between 2 observers ( $p < 0.001$ , intraclass correlation coefficient = 0.93). The mean value was  $87.87 \pm 22.92$  degrees for the 1st observer (range 51-155 degrees) and  $85.40 \pm 25.80$  degrees for the 2nd observer (range 45-166 degrees). No statistically significant correlation was found between biliary confluence angle and age, gender or body mass index. The lower and upper bounds of 95% confidence interval for mean were  $80.54-95.20$  degrees for the 1st observer and  $77.14-93.65$  degrees for the 2nd observer.

**Conclusion:** Normal biliary confluence angle is independent of age, gender, and body mass index.

**Key Words :** *Biliary Tract, Cholangiopancreatography, Bile Ducts*

Başvuru tarihi: 01.11.2010 • Kabul tarihi: 25.06.2010

İletişim

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Intrahepatic bile ducts form two large trunks -right and left hepatic duct- which leave the liver at the transverse fissure. The union of these trunks is the common hepatic duct and the biliary confluence angle is the angle be-

tween the right and left hepatic ducts. The classic biliary junction which is seen in 53%-72% of normal subjects, is formed outside the liver parenchyma, just before the common biliary duct arises (1,2).

The confluence angle is not measured during the routine MR cholangiopancreatography (MRCP) readings. However widening of the angle may be relevant when a mass is located in this area. In patients with intrahepatic bile duct diseases like primary sclerosing cholangitis careful attention is paid to the bile duct configuration in order not to miss signs of an early disease. In some of these patients we observed that the width of the biliary confluence angle was wide but hence no normal values were described for this angle we could not produce any quantitative results. When we started to monitor the confluence angle particularly, we observed that the width of the confluence angle varied individually. Before going any further we wanted to determine if there would be demographic factors contributing to the width of the biliary confluence.

The aim of this study is to evaluate the mean biliary confluence angle on MRCP images and to determine whether there is a relation between the angle and age, gender, and body mass index of the subjects.

## Materials and Methods

The study population was drawn from the patients referred to MRCP between May 2006 and December 2006 for various indications; including a history of pancreatitis, pancreatic masses, liver hydatid cysts, abnormal cholestasis parameters or suspected biliary dis-

ease. A total of 40 patients who denied a history of prior liver surgery, and in whom MRCP excluded bile duct variations, biliary diseases or chronic parenchymal liver disease were enrolled. There were 18 women and 22 men aged 22-86 years (mean age 51 years). MRCP was performed on a 1.0 Tesla MR system (Signa LX Horizon; General Electric Medical Systems, Milwaukee, WI) using phased array coil and 2 dimensional single-shot-fast spin-echo (SSFSE) sequence. All scans were performed by the same radiology technician. A 5- mm thick contiguous multisection acquisition was performed in the axial plane through the upper abdomen and the common bile duct was localized in the axial plane. The thick slabs (40 mm) in the oblique coronal plane were obtained centering the common bile duct. The breath-hold period was 2 sec for each slab. The imaging parameters of the thick slabs could change individually for each patient but they could be obtained as; TR: 1700-15.000 msec, TE: 900-110 msec, bandwidth: 25-31.2 kHz, field of view: 35-40 cm, matrix size: 256x256 pixels, number of excitations: 0.5-1.

The MRCP images were analyzed at the workstation and the confluence angle was measured independently by 2 observers on 3 successive coronal oblique thick-collimation images where the angle is widest. The averages of the values obtained were used as statistical data. Intraclass correlation coefficients were used in order to assess the interobserver agreement between 2 read-

ers. Mann-Whitney U test was used to analyze the correlation between the biliary confluence angle and the age, gender, and body mass index of the patients.

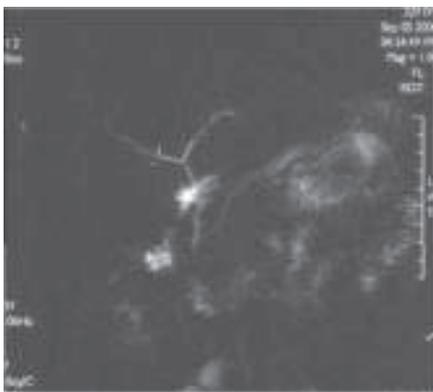
## Results

Coronal oblique thick-collimation images were adequate to measure the biliary confluence angle in all patients. When comparing the measurements of the two observers we ensured that the most frequently measured images on which the biliary confluence angle was widest were the third, fourth, and fifth images. This was probably because the same technician performed all scans. The average body mass index was 26.8 kg/m<sup>2</sup> (range 17.9-42.2 kg/m<sup>2</sup>). Statistically there was almost perfect agreement between 2 observers ( $p < 0.001$ , intraclass correlation coefficient = 0.93). The mean value was  $87.87 \pm 22.92$  degrees for the 1st observer (range 51-155 degrees) and  $85.40 \pm 25.80$  degrees for the 2nd observer (range 45-166 degrees) (Figures 1-3). No statistically significant correlation was found between biliary confluence angle and age, gender or body mass index ( $p > 0.05$ ). The lower and upper bounds of 95% confidence interval for mean were 80.54-95.20 degrees for the 1st observer and 77.14-93.65 degrees for the 2nd observer.

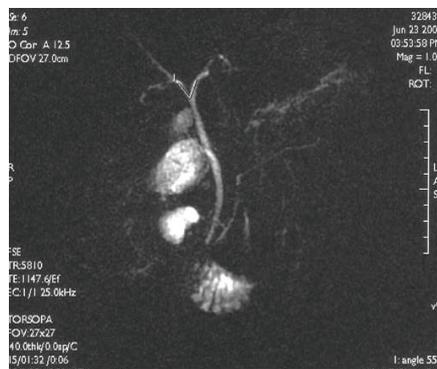
## Discussion

Intrahepatic bile ducts course with the portal vein branches. During the embryological development, the divisions of the portal vein appear before the development of the hepatic ducts hence the bile ducts follow the course of the portal vein divisions (3,4).

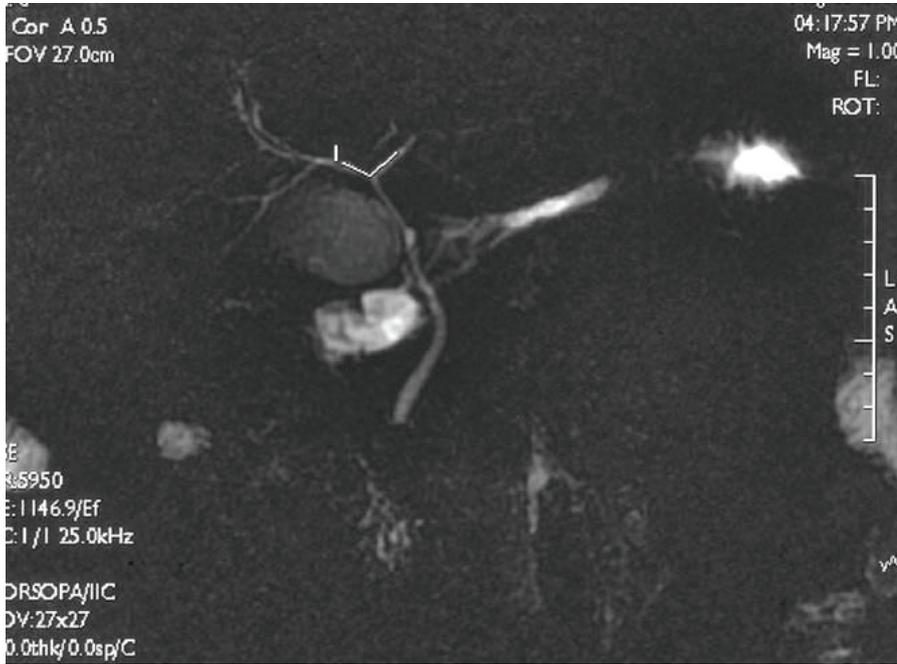
MRCP is widely used as the initial imaging method to evaluate the pancreatobiliary pathologies and it has a high diagnostic accuracy (5,6). In patients with suspicion of biliary diseases, MRCP is a good non-invasive alternative to endoscopic retrograde cholangiopancreatography (ERCP) and when interpret-



**Figure 1:** The mean angle was found about 86 degrees in the classic type of biliary confluence.



**Figure 2:** A relatively narrow biliary confluence angle (55 degrees) is seen on a thick slab MRCP image of a patient.



**Figure 3:** On MRCP image of another patient the angle is measured as 112 degrees.

ing MRCP images the course of the bile ducts can be a clue for a hepatic parenchymal changes which may cause dislocation or distortion of the ducts.

The anatomy of the intrahepatic bile ducts, especially the branching patterns at the

biliary confluence are widely discussed in the literature because of the surgical importance of this area in liver transplantation (7-10). Nevertheless there has been no study describing the variability of the biliary confluence angle width.

In our study of 40 adults, the mean angle of the biliary confluence was about 86 degrees. The values for the biliary confluence angle ranged widely in normal subjects. Also age, gender and body mass index did not appear to have an effect on the confluence angle. Perceptual differences in the image evaluation and angle measurement were unlikely with this technique. The intraclass correlation coefficient for the two readers showed almost perfect agreement.

The width of hilar confluence angle may provide a clue about the presence of hilar masses, parenchymal atrophy of the liver and periportal space lesions if there is an alteration in the angle on consecutive MRCP studies. However, we believe that measuring this angle is of limited use as a practical criterion of such diseases on routine MRCP readings because of the wide range of normal values. Severe deviations from normal limits, especially in follow-up patients, may arise suspicion of abnormality, and may warrant additional investigation for hilar hepatobiliary lesion on conventional T1- and T2-weighted MR images.

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