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Cytogenetic Studies of the Leukocytes of Couples with Habitual Abortions

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Karyotypes were prepared from peripheral blood leukocytes in 18 couples with histories of habitual abortions. The standard chromosome analysis and G-banding techniques were studied. The abnormal karyotypes seen were one case with 20% of 45,XX,-14,-15, t(14/15), one case of 46,XY/45,XY,-21 mosaicism, one case of 45,XX,-14,-21,t(14/21), one case of 46,XX/45,XO mosaicism and one case of 46,XYq+. Many other types of chromosomal abnormalities from many reports in couples with spontaneous abortions are discussed.

Key Words: Cytogenetic study, Habitual abortions

The causes of spontaneous abortion are often unknown, but probably multiple, including abnormalities of placentation, infectious or systemic disease, hormonal inbalance, immunological factors, anatomical defects, and genetic errors (Glass and Golbus, 1978). The speculation on the possibility of chromosomal abnormalities in spontaneous abortion were first demonstrated by Penrose and Delhanty (1961). Since then, many cytogenetic studies have clearly demonstrated that a significant proportion of early human spontaneous abortions have a chromosome anomaly (Jacobsen *et al.*, 1963; Bishun *et al.*, 1964) and it is now accepted that chromosomal aberrations involving trisomy, monosomy and translocations are a major cause of early abortion (Carr, 1967; Makino *et al.*, 1967). Because of the possible association between chromosomal abnormalities in the fetus and chromosomal rearrangements in one of its parents, as predisposing to recurrent abortion, cytogenetic investigations on repeated abortions and stillbirths have been started on couples who have experienced repeated spontaneous abortions and/or stillbirths (Schmid, 1962; Carr, 1963; Rowley *et al.*, 1963; Bishun and Morton, 1968; Bhasin *et al.*, 1973; De La Chapells *et al.*, 1973). Since then, there have been many reports seeking chromosome anomalies on couples who suffered from chronic fetal wastage (Yunis *et al.*, 1964; Wingate, 1965; Jacobson *et al.*, 1966; Walzer *et al.*, 1966; McKay *et al.*, 1967; Pergament *et al.*, 1968; Stenchever *et al.*, 1968; Lucas, 1969; Predescu *et al.*, 1969; Wilson, 1969; Hsu *et al.*, 1970; Kadotani *et al.*, 1970; Sparkes and DeChieri, 1970; Grotsky *et al.*, 1971; Hsu, *et al., 1972; Stenchever and Jarvis, 1971; Kim et al.*, 1975; Köener *et al.*, 1975; Tsenghi *et al.*, 1976; Lauritsen, 1976; Byrd *et al.*, 1977; Stenchever *et al.*, 1977; Kajii and Ferrier, 1978; Lancet

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et al., 1978; Mameli *et al.*, 1978; Mannuti *et al.*, 1978; Neu *et al.*, 1979; Kardon *et al.*, 1980; Ward *et al.*, 1980). A review by Kajii *et al.* (1974) on 17 cytogenetic studies on couples with a history of recurrent abortions revealed 25 individuals with structural chromosome abnormalities from a total of 1,793 men and women karyotypes. Their frequency (1.3%) was more than four times that in the general adult population (0.2-0.3%, Jacobs, 1977). Cytogenetic studies on spontaneous abortuses also indicated that unbalanced translocations account for 2 to 4% of all chromosomally abnormal abortuses (Carr and Gedeon, 1975). They assumed that aborters with balanced translocations transmit unbalanced products of those translocations to their abortuses.

Since chromosome analysis is frequently recommended for couples who have two or more episodes of reproductive loss, and since there are no studies in the Korean population, the purpose of the present investigation was to determine the types of chromosome abnormalities in 18 Korean couples with repeated spontaneous abortions.

MATERIALS AND METHODS

Chromosome studies were carried out in 18 couples who had a history of two or more spontaneous abortions or live births with abnormalities. All the subjects were from private and obsteric units of several hospitals in the city of Seoul. Maternal ages were between 23 and 32 and paternal ages were between 29 and 36.

Cells from peripheral blood were cultured by a modification of the method of Moorhead et al (1960) in GIBCO blood culture media. The slides were made by air-drying and stained with Giemsa. The trypsin-G-banding preparations were made by the Seabright (1971) technique. In most specimens, at least 20 metaphases were selected for chromosome study. The photomicrographs were made using a light green filter and Kodak high contrast copy film in a AO photomicroscope.

RESULTS

Among eighteen couples, twelve couples and six individuals had a modal chromosome number of 46 and normal female and male chromosome constitution (46, XX and 46, XY) (Fig. 1). Chromosome abnormalities were noted in three females and two males in the study (Table 1).

Couple 4. This 30-year-old female was referred because of a history of four first-trimester abortions. A routine karyotype appeared with a modal chromosome count of 45. Only four members of the D group could be identified but an additional metacentric chromosome was present (Fig. 2). Although this was assumed to be a translocation between the 14 and 15 [45, XX,-14,15,t(14/15)], it was not certain without the G-banding picture.

Couple 6. This 28-year-old female had a history of four consecutive first-trimester abortions with no successful pregnancies. Wife's karyotype was a normal 46,XX. In the husband's karyotype there appeared two kinds of cells: 80% of the cells had karyotype 46,XY, and 20% had a 45,XY,-21 (Fig. 3 and 4).

Couple 9. This man and wife were referred for genetic counseling following three spontaneous abortions and a male child with Down's syndrome. The husband's karyotype was a normal 46,XY. On the basis of conventional stain without banding, the 29 year-old wife revealed 45 chromosomes with balanced translocation of 14 and 21 [45,XX,-14-21,t(14/21)] in 20% of the cells (Fig. 5).

Couple 12. The 32-year-old female had a history of difficulty in conceiving and three spontaneous first-trimester abortions. The

Table 1. Chromosomal abnormalities in couples with repeated spontaneous abortions

Couple No.	No. of abortions	Abnormal children	Chromosome abnormalities		Type of abnormalities
			Husband	Wife	
1	3	0	−	−	Normal
2	3	0	−	−	Normal
3	2	0	−	−	Normal
4	4	0	−	+	45,XX,-14,-15,t(14/15)
5	3	0	−	−	Normal
6	4	0	+	−	46,XY/45,XY,-21(20%)
7	2	0	−	−	Normal
8	3	0	−	−	Normal
9	3	1	−	+	45,XX,-14,-21,t(14/21)(20%)
10	3	0	−	−	Normal
11	3	0	−	−	Normal
12	3	0	−	+	46,XX/45,XO(30%)
13	3	0	−	−	Normal
14	5	0	+	−	46,XYq+(30%)
15	4	0	−	−	Normal
16	2	0	−	−	Normal
17	3	0	−	−	Normal
18	3	0	−	−	Normal

husband was found to have a normal 46,XY karyotype. In the wife's culture 30% of the cells were 45,XO and the remaineder had a 46,XX karyotype (Fig. 6).

Couple 14. This couple had five pregnancies, all ending within 10 weeks. The wife's karyotype was normal 46,XX, but the husband who was 34 years old had a clinical diagnosis of secondary hypogonadism. Examination of his chromosomes showed an extended long arm of the Y chromosome (Fig. 7 and 8) in 30% of the cells.

DISCUSSION

In this study, all cases were referred without any information regarding gynecologic examinations, sperm count of the husband, hormone tests or other tests results. They came to us for genetic counseling after they had been seen by obstetric units of hospitals because of censecutive first-trimester abortions. The main problem of concern in the present study was whether chromosomal anomalies found in the couples could be causally related to recurrent spontaneous abortions in the Korean population.

The present study shows chromosome abnormalities in 5 individuals of the 18 couples studied, a frequency of 14%, which is a considerably higher rate than any other reported studies. The frequency of chromosomal abnormalities in couples in the general population examined for repeated spontaneous abortions is 5.4% (Pergament *et al.*, 1968; Wilson, 1969; Kulazhenko *et al.*, 1972; Käosaar and Mikelsaar, 1973) and Tsenghi *et al.* (1976) found 7.79% by the new staining technics. The reported cases of chromosome studies in repeated spontaneous

Table 2. Major cytogenetic studies in the literature of couples with fetal wastage

Investigator	Year	Findings
Jacobsen et al	1963	46,XX,-13,-13,+13q-,t(13q/13q)
Bishun et al	1964	46,XX/45,XO
		46,XX,Ds+
Pergamet et al	1968	45,XX,-D,-D,t(D/D)
		46,XX,18p+
		46,XX,21p-
Bishun & Morton	1968	46,XX/45,XO
Stenchever et al	1968	45,XX,-14,-15,t(14/15)
Predescu et al	1969	46,XX/45,XO
Hsu et al	1970	46,XY/47,XY,+D
		46,XX,2 inv(p+q-), 6 br
Kodotani et al	1970	46,XX,-5,-11,t(5q/11q),+11q-
		45,XY,-14,-21,t(14q/21q)
Sparkes et al	1970	45,XX,-D,-D,t(Dq/Dq)
Grostsky et al	1971	46,XX,t(4/5)
Stenchever & Jarvis	1971	45,XX,-D,-D,t(D/D)
		46,XX/47,XXX
		47,XYY
Lewis and Ridler	1972	45,XY,rob(22;22)
Hsu et al	1972	45,XO/46,XX/47,XXX
Lucas et al	1972	47,XX,+14,t(5/10) (q33;q11)
		46,XX,t(5/10)(q33;q11)
Schwinger	1973	45,SY,rob(22;22)
Kim et al	1975	46,XX,t(17;19) (q23;p13)
		46,XX,t(4;11) (q25;q13)
		46,XX,t(13;22) (q22;q12)
		45,XO/46,XX/47,XXX
Maeda & Ohno	1976	45,XY,rob(22;22)
Tsenghi et al	1976	46,XY,t(18q-/5p+)
		46,XY/46,XY,t(9q+/7p-)
		46,XY,t(Yq-/9p+),oqh+
		46,XY,t(7q-/1q+)
		45,XX,-D,-D,+t(D/D)
		46,XX,inv(9q-/p+)
		46,XY,Dp+
		46,XY,Gp+
		46,XX,Dp+
		46,XX,Gp+
		46,XX,DP-
		46,XX,9qh+
		46,XX,1qh+
		46,XX,Gp-
		45,XY,rob(22;22)

Stenchever et al	1977	46,XX,t(2p-;7p+)
		46,XX,t(2q+;8q-)
		46,XX,t(3p-;8q+)
		46,XX,t(1p+;17q-)
		46,XX,t(7q+;10p-)
		46,XX,t(1q-;16q+)
		46,XX,t(1p+;2q-)
Byrd et al	1977	46,XX,t(2;6) (q3;p2)
		46,XY,t(1;9) (p3;q2)
		45,XY,-13,014,+t(13q;14q)
		46,XX,t(5:21) (5q-;21q+)
		46,XX,t(3:13) (q29;q22)
		45,XX,013,021,t(13q;21q)
Kajii & Ferrier	1978	46,XY,t(13q-;18q+)
		46,XX,t(10;12) (122;124)
		46,XX,t(13q;14q)
		46,XY,t(13q;14q)
		47,XXX
Mameli et al	1978	45,XY,-22,t(22/22)
Neu et al	1979	45,XX,-13,-14,t(13q;14q)
		45,XY,-13,-14,t(13q;14q)
Gahmberg et al	1980	45,XX,-13,-15,t(13/14)
		45,XX,-13,-14,t(13/14)
Kardon et al	1980	46,XY,t(8;10) (q24;p11)
		46,XY,t(12;29) (q22;p12)
		46,XX,t(2;6) (q33;q27)
Ward et al	1980	46,XX,15ps+
		46,XX,inv 9(p11q13)
		46,XX,inv 2(p11q13)
		45,X/46,XX

abortions up to 1980 are summarized in Table 2.

Jacobsen (1963) reported a translocation in the 13-15 group as a cause of partial trisomy and spontaneous abortion in the same family. A total of 68 couples and 5 individuals with habitual abortion histories were studied by Stenchever *et al.* (1968; 1969). They discovered one case of 14/15 translocation carrier. Pergament *et al.* (1968) also discovered one parent with a D/D translocation, and others including 18p+ and Gp- from 39 couples and four women who experienced repeated spontaneous abortions and/or stillbirths. The findings in the families of the Sparkes and DeChieri's (1970) report illustrated the relationship of a chromosome translocation to recurrent fetal wastage for some carrier parents. Kodotani *et al.* 1970), Grotsky *et al.* (1971) and Lucas *et al.* (1972) described families with B/C and D/G translocations associated with recurrent abortions. A recent study (Stenchever *et al.*, 1977) of couples with a history of 3 or more spontaneous abortions indicated that a large number of the women (31.2%) were balanced translocation carriers.

Lewis and Ridler (1972), Schwinger (1973), Maeda and Ohno (1976) and Mameli *et al.* (1978) found 22/22 Robertsonian translocation in couples with recurrent abortions. Bishun *et al.* (1964) investigated chromosomal mosaicism, such as XX/XO, in a case of repeated abortion. Bishun and Morton (1968) reported an unusually large satellite pair one group D chromosome and mosaicism (45,XO/46,XX) for cultured leukocytes examined among 27 patients, each of whom who had lost the products of conception on two or more occasions. Subfertility and repeated spontaneous abortions have also been described in individuals with sex chromosome anomalies, such as XO/XX, XX/XXX and XXY(Predescu *et al.*, 1969; Stenchever and Jarvis, 1971). Hsu *et al.* (1972) found triple mosaicism, 45,XO/46,XX/47, XXX in two women with normal phenotype who had histories of fetal wastage. Lauritsen (1976) found three translocation carriers and an XXX woman among the 259 couples and 9 women aborters studied. A consecutive series of 50 couples with a history of fetal wastage were studied cytogenetically with the banding technique (Kim *et al.*, 1975). They found 3 women who were balanced reciprocal translocation carriers (6%) and 1 case with 45,XO/46,XX/47, XXX mosaicism. Kijii and Ferrier (1978) also carried out a cytogenetic survey of 783 aborters. It revealed 4 women and two men as balanced translocation carriers and a woman with an XXX karyotype. Tsenghi *et al.*, (1976) also reported on the frequency of translocations in couples with repeated spontaneous abortions in the Greek population with the banding technique. They found a 3.25% incidence of chromosomal rearrangements in one of the parents. Byrd *et al.* (1977) reported four balanced translocation carrier parents among 59 couples with histories of recurrent abortions. Neu *et al.* (1979) reported one woman with a 45,XX, t(13q14q) who had three consecutive first-trimester abortions. Ward et al (1980) reported chromosome variations in six individuals out of 100 couples examined for a history 45,XO/46, XX was found. Others were 46,XX,15ps-, two of 46,XXinv(9)(p11q13), 46,XX,inv(2)(p11q13), and breaks in 16q22 of 13% of cells. Kardon *et al.* (1980) found a structural rearrangement of chromosomes in couples with a history of having borne a child with multiple congenital abnormalities.

Couples with a history of subfertility and/or multiple spontaneous abortions should be studied cytogenetically not only to detect balanced structural abnormalities but also to search for chromosomal mosaicism. If a chromosome anomaly is found, and precisly identified, a more exact prognosis for future pregnancies can be given and antenatal diagnosis may be offered in suitable cases. Although parental chromosome anomalies are not a frequent cause of recurrent abortion, they occur more commonly than in the general population and it is useful to examine both parents cytogenetically. In all problems of counseling involving cytogenetic abnormalities, if a chromosome anomaly is found, the important thing is to discuss with the patient and the spouse the statistical probabilities involved on the basis of segregation patterns. The patient and spouse then are encouraged to discuss the problem and arrive at their own conclusion regarding future pregnancies. If a pregnancy occurs, it is now possible to utilize amniocentesis and the culture of amniotic fluid cells to make an antenatal evaluation of the fetus.

REFERENCES

Bhasin MK, Foerster W, Fuhrmann W: *A cytogenetic study of recurrent abortion. Humangenetik 18:139-148, 1973*

Bishun NP, Mannion PL, Neely MR, Burke G: *Chromosomal mosaicism in a case of repeated abortion. Lancet 1:936, 1964*

Bishun NP, Morton WRM: *Chromosome studies on women who have two or more unsuccessful pregnancies. J Obstet Gynec Brit Comm 75:66-70, 1968*

Byrd JR, Askew DE, McDonough PG: *Cytogenetic findings in fifty-five couples with recurrent fetal wastage. Fertil Steril 28:246-250, 1977*

Carr DH: *Chromosome studies in abortuses and stillborn infants. Lancet 2:603, 1963*

Carr DH: *Cytogenetic aspects of induced and spontaneous abortions. Clin Obstet Gynec 15:203-219, 1972*

Carr DH, Gedeon M: *Population cytogenetics of human abortuses, in Hook EB and Porter IH ed: Population cytogenetics. Studies in human, New York 1975, Acadamy Press, Inc p 374*

De La Chapells A, Schröder J, Kohkonen J: *Cytogenetics of recurrent abortion or unsuccessful pregnancy. I J Fertil 18:215, 1973*

Glass RH, Golbus MS: *Habitual abortion. Fertil Steril 29:257-265, 1978*

Grotsky H, Hsu LYF, Hirschhorn K: *A case of cri du chat associated with cataracts and transmitted from a mother with a 4/5 translocation. J Med Genet 8:369, 1971*

Hsu LYF, Barcinski M, Shapiro LR, Valderrama E, Gertner M, Hirschhorn K: *Parental chromosomal aberrations accociated with multiple abortions and an abnormal infant. Obstet Gynec 37:723-730, 1970*

Hsu LYF, Garcia FP, Grossman D, Kutinsky E, Hirschhorn K: *Fetal wastage and maternal mosaicism. Obstet Gynec 40:98-103, 1972*

Jacobs PA: *Epidemiology of Chromosome abnormalities in man. Am J Epidemiol 105:180-191, 1977*

Jacobsen P, Dupont A, Mikkelsen M: *Translocation in the 13-15 group as a cause of partial trisomy and spontaneous abortion in same family. Lancet 2:584-585, 1963*

Jacobsen P, Mikkelsen M, Froland A, Dupont A: *Familial transmission of a translocation between two non-homologous large acrocentric and autoradiographic studies. Ann Hum Gent Lon 29:391-399, 1966*

Kadotani T, Ohama K, Sofuni T, Hamilton HB: *Aberrant karyotypes and spontaneous abortion in a Japanese family. Nature 225:735-737, 1970*

Kajii T, Ferrier A: *Cytogenetics of abortuses. Am J Obstet Gynec 131:33-38, 1978*

Kajii T, Meylan J, Mikamo K: *Chromosomal anomalies in three successive abortuses due to paternal translocation t(13q-18q+). Cytogenet Cell Genet 13: 426-436, 1974*

Käosaar ME, Mikelsaar AVN: *Chromosome investigation in married couples with repeated spontaneous abortions. Humangenetik 17:277-283, 1973*

Kardon NB, Davis JG, Berger AL, Broekman A: *Incidence of chromosomal rearrangement in couples with reproductive loss. Hum Genet 53:161-164, 1980*

Kim HJ, Hsu LYF, Paciuc S, Cristian S, Quintana A, Hirschhorn K: *Cytogenetics of fetal wastage. New Eng J Med 293:844-847, 1975*

Körner H, Agricola H, Bayer H: *Translocation t(7q+; 13q-) associated with recurrent abortion. Humangenetik 28:83-86, 1975*

Kulazhenko VP, Lazink GI, Levehenko NN: *Chromosome aberrations found in parents in cases of recurrent abortions. Genetika (Moskva) 8:154, 1972. Cited in Excerpta Med Hum Genet 11:571, 1971*

Lancet M, Siegel A, Sindal RC: *Chromosoma; aberrations in couples with habitual abortion. Harefuah 94:67-69, 1978*

Lauritsen JG: *Aetiology of spontaneous abortion. A cytogenetic study of 288 abortuses and their parents. Acta Obstet Gynec Scond (Suppl) 52:1, 1976*

Lucas M: *Translocation between both members of chromosome pair number 15 causing recurrent abortion. Ann Hum Genet 32:347, 1969*

Lucas M, Wallace I, Hirschhorn K: *Recurrent abortions and chromosome abnormalities. J Obstet Gynec Brit Comm 79:1119-1127, 1972*

Maeda T, Ohno M: *A 22/22 translocation carrier with recurrent abortions demonstrated by a Giemsa*

banding technique. Hum Genet 31:243-245, 1976

Makino S, Ikeuchi T, Sasaki M, Muramoto J Shimba H, Fujimoto S, Matsuda S: *A preliminary study of the chromosomes in spontaneous abortions. Proc Jap Acad 43:552-555. 1967*

Mameli M, Cardia S, Milia A, Seabright M: *A further case of a 22:22 Robertonian translocation associated with recurrent abortions. Hum Genet 41:359-361, 1978*

McKay RJ Jr, Hodgkin WE, Whitte EH: *Chromosomes of couples with repeated spontaneous abortions (Abstr) Ped Res 1:208, 1967*

Mennuti MT, Jingeleski S, Schwarz RH, Mellman WJ: *An evaluation of cytogenetic analysis as a primary tool in the assessment of recurrent pregnancy wastage. Obstet Gynec 52:308-313, 1978*

Moorhead PS, Nowell PC, Mellman WJ, Battips DM, Hungerford DA: *Chromosome preparations of leukocytes cultured from human peripheral blood. Exp Cell Res 20:613-616, 1960*

New RL, Entes K, Bannerman RM: *Chromosome analysis in cases with repeated spontaneous abortions. Obstet Gynec 53:373-375, 1979*

Penrose LS, Delhanty JDA: *Triploid cell cultures from macerated foetus. Lancet 1:1261, 1971*

Pergament E, Kadotani T, Sato H: *Chromosome studies in repeated spontaneous abortions and stillbirth. Am J Obstet Gynec 100:912-917, 1968*

Predescu V, Christodorescu D, Tautu C, Cnovirnache M, Constantinescu E: *Repeated abortions in XO/XX mosaicism. Lancet 2:217, 1969*

Rowley PT, Marshall R, Ellis JR: *A genetical and cytological study of repeated spontaneous abortion. Ann Hum Genet 27:87-100, 1963*

Schmid W: *A familial chromosome abnormality associated with repeated abortions. Cytogenet 1:199-209, 1962*

Schwinger E: *Translocation 22/22? Lancet 2:854-855, 1973*

Seabright M: *A rapid banding technique for human chromosomes. Lancet 2:971, 972, 1971*

Sparkes RS, DeChieri P: *Inherited 13/14, chromosome translocation as a cause of human fetal wastage. Obstet Gynec 35:601-607, 1970*

Stenchever MA, Jarvis JA: *Cytogenetic studies in reproductive failure. Obstet Gynec 37:83-89, 1971*

Stenchever MA, Jarvis JA, Macintyre MN: *Cytogenetics of habitual abortion. Obstet Gynec 32:548-555, 1968*

Stenchever MA, Macintyre MN, Javis JA: *Cytogenetics of 32 infertile couples. Obstet Gynec 33:380-382, 1969*

Stenchever MA, Parks KJ, Daines TL, Allen MA, Stenchever MC: *Cytogenetics of habitual abortion and other reproductive wastage. Am J Obstet Gynec 127:143-150, 1977*

Tsenghi C, Metaxotous-Stavridaki C, Strataki-Beneton M, Kalpin-Mavrou A, Matsaniotis N: *Chromosome studies in couples with repeated spontaneous abortions. Obstet Gynec 47:463-468, 1976*

Walzer S, Favara B, Ming PL, Gerald S: *A new translocation syndrome (3/B). New Eng J Med, 275: 290-298, 1966*

Ward BE, Henry GP, Robinson A: *Cytogenetic studies in 100 couples with recurrent spontaneous abortions. Am J Hum Genet 32:549-554, 1980*

Wilson JA: *A prospective, cytogenetic study of recurrent abortion. J Med Genet 6:5-13, 1969*

Wingate L: *Chromosome abnormality as a possible cause of habitual abortion. Bristol Medicochir J 80:295, 1965*

Yunis J, Alter M, Hook EB: *Familial D/D tranlocation: Report of a pedigree and DNA replication analysis. New Eng J Med 271:1133, 1964*

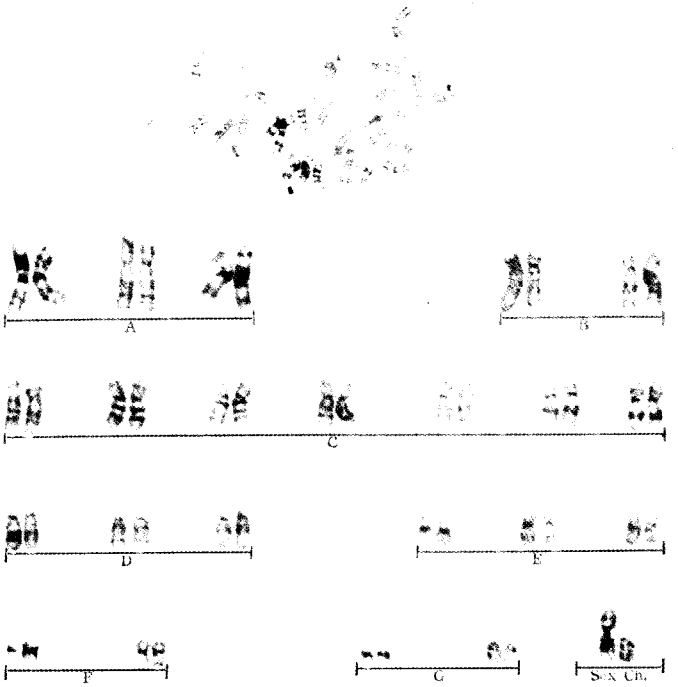

Fig. 1. The normal male chromosome constitution of 46,XY.

Fig. 2. Karyotype of wife, couple 4: 45,XX,-14,-15,t(14/15) (Conventional stain).

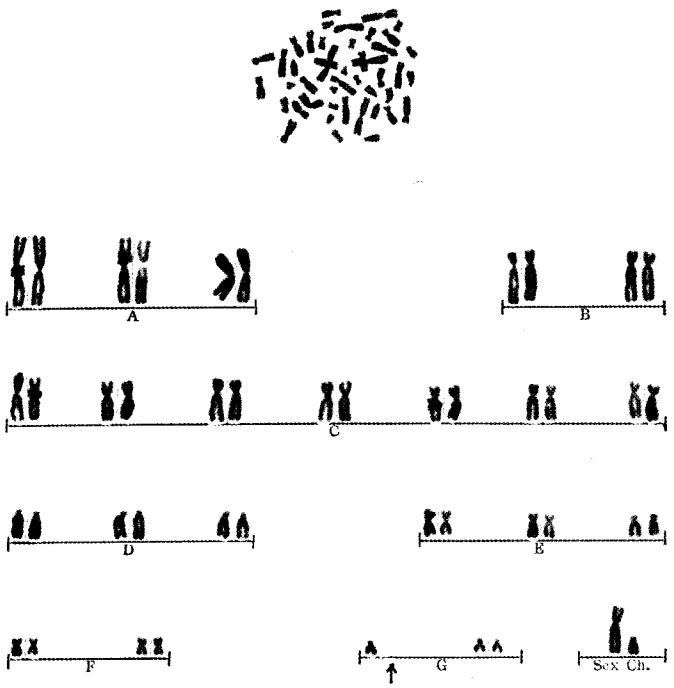

Fig. 3. Karyotype of husband, couple 6: 45,XY,-21 (Conventional stain).

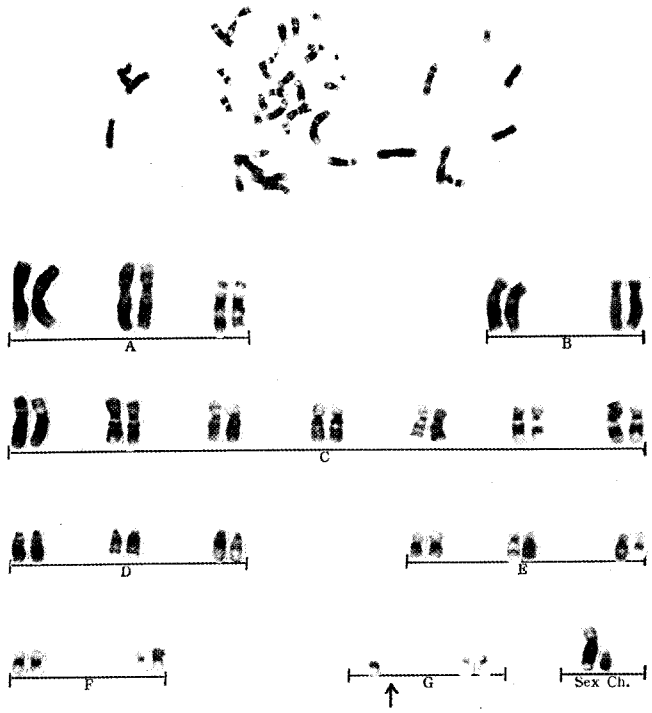

Fig. 4. G-banded karyotype of Fig. 3, 45,XY,-21.

Fig. 5. Wife of couple 9 karyotype showing 45,XX,-14,-21,t(14/21) (Conventional stain).

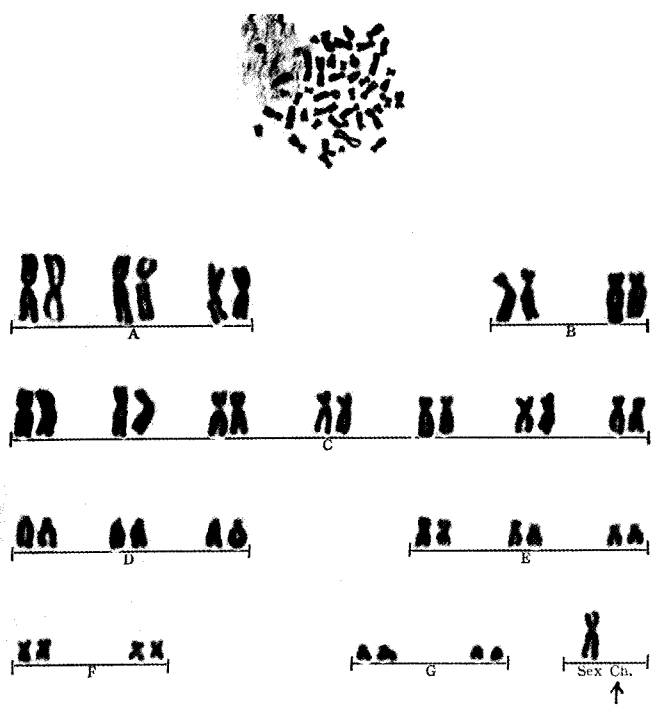

Fig. 6. Karyotype of wife, couple 12: 45,XO (Conventional stain).

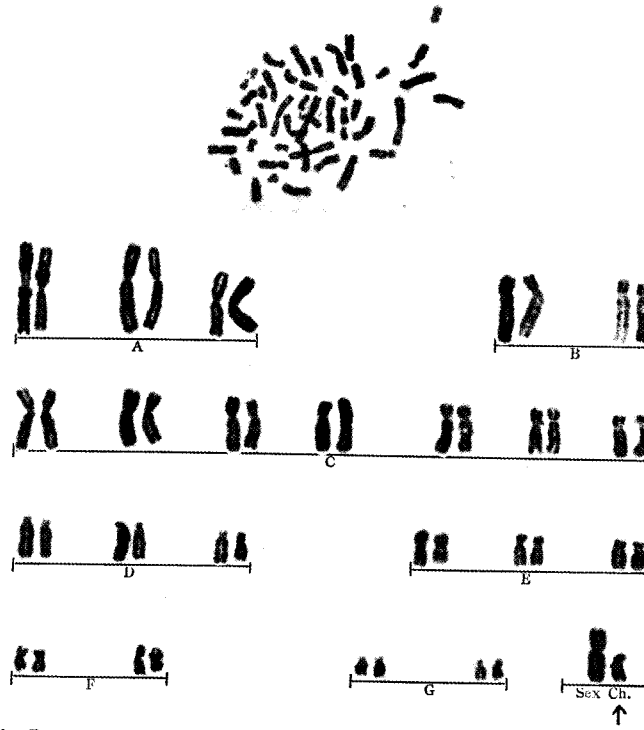

Fig. 7. Karyotype of husgand, couple 14: 46,XYq+ (Conventional stain).

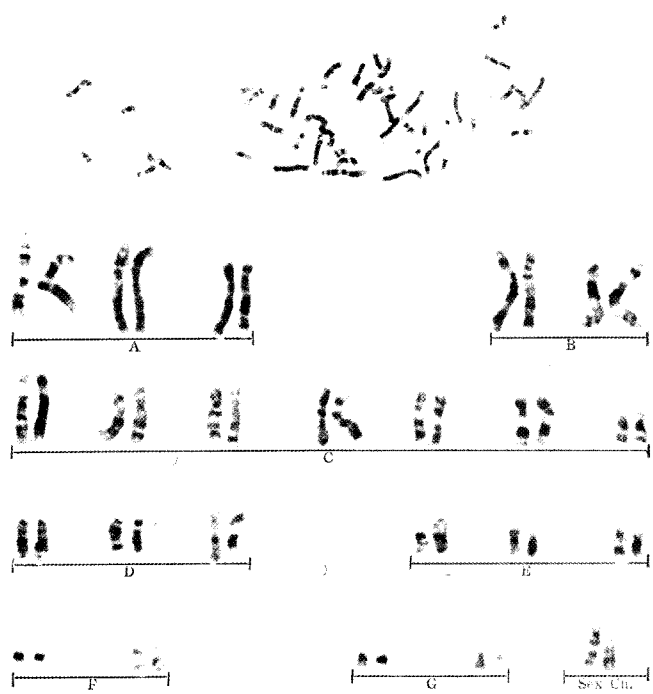

Fig. 8. G-banded karyotype of Fig. 7, 46,XYq+.