CHAPTER 22

Committee 20

The Obstetric Vesicovaginal Fistula in the Developing World

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"In vast areas of the world, in South East Asia, in Burma, in India, in parts of Central America, South America and Africa 50 million women will bring forth their children this year in sorrow, as in ancient Biblical times, and exposed to grave dangers. In consequence, today as ever in the past, uncounted hundreds of thousands of young mothers annually suffer childbirth injuries; injuries which reduce them to the ultimate state of human wretchedness.

Consider these young women. Belonging generally to the age group 15-23 years, and thus at the very beginning of their reproductive lives, they are more to be pitied even than the blind, for the blind can sometimes work and marry. Their desolation descends below that of the lepers, who though scarred, crippled and shunned, may still marry and find useful work to do. The blind, the crippled and the lepers, with lesions obvious to the eye and therefore appealing to the heart, are all remembered and cared for by great charitable bodies, national and international.

Constantly in pain, incontinent of urine or faeces, bearing a heavy burden of sadness in discovering their child stillborn, ashamed of a rank personal offensiveness, abandoned therefore by their husbands, outcasts of society, unemployable except in the fields, they live, they exist, without friends and without hope.

Because their injuries are pudendal, affecting those parts of the body which must be hidden from view and which a woman may not in modesty easily speak, they endure their injuries in silent shame. No charitable organization becomes aware of them. Their misery is utter, lonely, and complete."

—- RHJ Hamlin and E. Catherine Nicholson, (Hamlin and Nicholson 1966)

People in the developing and the industrialized worlds share a common humanity and with this comes a common susceptibility to the pathophysiology that may lead to urinary incontinence; however, the obstetric fistula is the one continence issue that is both unique to and particularly prevalent in developing countries. Although the obstetric fistula was once common in Western Europe and the United States, it is virtually unknown in these regions today. The prevalence of obstetric fistulas has also fallen precipitously in the more industrialized nations of Asia and Latin America; but fistulas remain both prevalent and problematic in Africa and in the less developed regions of Asia and Oceania. This disparity between the rich and poor nations of the world requires special attention, particularly because obstetric fistulas can be completely and reliably prevented by the provision of proper health care. It is this lack of appropriate health care—-specifically the lack of appropriate health care for pregnant women in impoverished Third World countries—-that is responsible for the widespread prevalence of this devastating cause of incontinence in certain areas of the world today. The obstetric fistula has vanished from industrialized nations because those countries created efficient and effective systems of maternity care that provide effective access to emergency obstetric services for women who develop complications during labor. The fistula problem in Third World countries will not be solved until those nations also develop effective systems of maternal health care. Unfortunately, "Safe Motherhood" has largely become an "orphan" initiative (Rosenfield and Maine 1985);(Graham 1998; Weil and Fernandez 1999). In virtually no other area in which health statistics are commonly collected is the disparity between the industrialized and the developing worlds as great as in the area of maternal health (AbouZahr and Royston 1991). This remains one of the most glaring, and one of the most neglected, issues of international social injustice in the world today. It is no surprise that Graham has called this the "scandal of the century" (Graham 1998).

This chapter provides an overview of the pathophysiology that leads to obstetric fistula formation and discusses the relationship of obstetric fistulas to the broader issue of maternal mortality with which it is inextricably linked. This chapter also summarizes the most important current issues in the treatment of obstetric fistulas and suggests directions for much-needed future research in this area.

I. LEVELS OF EVIDENCE CONCERNING OBSTETRIC FISTULAS

Scientific data on the problem of obstetric fistulas, their prevalence and the ways in which they should be treated, are limited by unusual historical circumstances. Prior to the middle of the 19th Century, an obstetric vesicovaginal fistula was generally regarded as an incurable and hopeless condition. It was only after the work of the American surgeon J. Marion Sims and his colleague and successor Thomas Addis Emmett (Sims 1852);(Emmet 1868); (Harris 1950); (Wall 2002); (Zacharin 1988) that surgical cure of this condition could be undertaken with reasonable confidence. As obstetrics began to develop into a more scientific medical specialty in the first half of the 20th Century, maternal mortality underwent a precipitous decline throughout Europe, the United States, and other developed nations (Loudon 1992a; Loudon 1992b). This meant that the obstetric fistula vanished from the clinical and social experience of the Western world just as Western medicine was starting to become more rigorously scientific. As a result of these historical circumstances, the Western medical literature on obstetric fistulas is old and relatively uncritical by current scientific criteria. This literature consists mainly of anecdotes, case series (some quite large), and personal experiences reported by dedicated surgeons who have labored in remote corners of the world while facing enormous clinical challenges with scanty or absent resources at their disposal (Evidence Levels 4 and 5). The committee charged with producing this report was able to locate only a handful of articles, all quite recent, that rise to a higher level of evidence. For example, there appears to be only one prospective, randomized clinical trial in the current medical literature on vesico-vaginal fistulas in the developing world (Tomlinson and Thornton 1998), and only one comparative study of surgical techniques in the repair of obstetric fistulas (Rangnekar, Imdad et al. 2000). This finding underlines how the problem of obstetric fistulas in developing countries has been neglected by the bioscientific medical community of the industrialized world. The paucity of well-designed studies makes it impossible to produce a sophisticated meta-analysis of hard scientific data on the obstetric fistula problem at this time. While acknowledging this difficulty, the members of the committee feel that it is possible to arrive at a consensus regarding most major aspects of the fistula problem. This report presents a general summary of the current state of our knowledge regarding obstetric fistulas in the developing world and the challenges presented by this condition. The committee regards this report as a point of departure for further work—-and a clarion call for further action on this problem—-acknowledging that many important issues remain unclear and urgently require more intensive scientific study.

II. THE RELATIONSHIP OF OBSTETRIC FISTULAS TO MATERNAL MORTALITY

The commonly accepted definition of a maternal death is “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes” (AbouZahr and Royston 1991). The most common measure of maternal mortality used for international comparative purposes is the maternal mortality ratio: the number of maternal deaths per 100,000 live births. The available statistics show huge discrepancies between the developed and the developing worlds (WHO, UNICEF et al. 2000). The overall world maternal mortality ratio is estimated at 400 maternal deaths per 100,000 live births. In developed regions of the world the ratio is 20 deaths per 100,000 live births, contrasted with 440 deaths per 100,000 live births in less developed regions. The worst statistics come from sub-Saharan Africa, where nearly 1% of all pregnant women can expect to die in any given pregnancy. There are many problems associated with the collection of maternal mortality statistics and the estimation of maternal mortality ratios, especially in developing countries, and these statistics are generally acknowledged to be underestimates to some (usually to a substantial) degree.

For an individual woman, the most important statistic is not the maternal mortality ratio, but rather the estimation of her risk of pregnancy-related death across her reproductive lifespan. A woman’s lifetime risk of maternal death is a function of her risk of dying in any particular pregnancy multiplied by the number of times she is likely to become pregnant. These risks are therefore highest in areas of high fertility where access to emergency obstetric care is poor. In the affluent, industrialized developed

regions of the world, a woman's lifetime risk of dying from an obstetric complication is small (1 in 2,800); but in impoverished Third World regions, her risk of death is substantial (1 in 61). In sub-Saharan Africa, the risk is even higher (1 in 16). Worldwide, the vast majority of maternal deaths are clustered in a handful of nations with large populations and marginal obstetric care. Only 13 countries account for 70% of all maternal deaths [India, Nigeria, Pakistan, Democratic Republic of the Congo, Ethiopia, Tanzania, Afghanistan, Bangladesh, Angola, China, Kenya, Indonesia and Uganda]. When ranked according to obstetric risk (maternal mortality ratio), virtually all of the most dangerous countries for pregnant women are found in sub-Saharan Africa. In rank order, the countries with the highest maternal mortality ratios (greater than 1,000 deaths per 100,000 life births) are Sierra Leone, Afghanistan, Malawi, Angola, Niger, Tanzania, Rwanda, Mali, Somalia, Zimbabwe, Chad, Central African Republic, Guinea Bissau, Kenya, Mozambique, Burkina Faso, Burundi and Mauritania (WHO, UNICEF et al. 2000). The maternal mortality estimates for 2000 are summarized in **Table 1**).

The majority of maternal deaths are due to five principal causes: hemorrhage, sepsis, hypertensive disorders of pregnancy, unsafe abortion, and obstructed labor (AbouZahr and Royston 1991). The vast majority of fistulas are due to obstructed labor. Not surprisingly, obstetric fistulas are most prevalent in areas where maternal mortality is high and where obstructed labor is a major contributor to maternal deaths. These are areas where access to emergency obstetric care is poor and as a result of the lack of effective infrastructure, accurate epidemiological information is also poor in these regions—-a continuing point of difficulty in the evaluation of maternal mortality in general and in the evaluation of obstetric fistulas in particular.

Obstetric fistula formation is linked directly to maternal mortality. Maternal mortality is embedded in a complex network of social issues that have to do with the social status of women, the distribution and availability of healthcare resources, perceptions about the nature and importance of maternal health problems, and the social, economic and political infrastructures of developing countries, but the common thread linking all of these factors together is poverty (Graham, Fitzmaurice et al. 2004). If one looks at the country rankings in the Human Development Index produced by the United Nations Development Programme, one finds that the countries with the worst maternal mortality problems are all heaped together at the bottom of the index: in fact, the 25 poorest countries in the world are all in sub-Saharan Africa. All of these countries have very high maternal mortality ratios and a high prevalence of vesicovaginal fistulas. Poor women die more fre-

Table 1. Maternal Mortality Estimates for 2000 (WHO, UNICEF, and UNFPA 2000)

	Maternal Mortality Ratio (Maternal deaths per 100,000 live births)	**Number of Maternal Deaths**	**Lifetime Risk of Maternal Death, 1 in:**
World total	400	529,000	74
Developed Regions*	20	2,5000	2,800
Europe	24	1,700	2,400
Developing Regions	440	527,000	61
Africa	870	235,000	16
Northern Africa**	130	4,600	210
Sub-Saharan Africa	920	247,000	16
Asia	390	323,000	65
Eastern Asia	55	11,000	840
South-central Asia	520	207,000	46
South-eastern Asia	210	25,000	140
Western Asia	190	9,800	120
Latin America & the Caribbean	190	22,000	160
Oceania	240	530	83

*Includes Europe, Canada, the United States of America, Japan, Australia and New Zealand which are excluded from the regional totals.

**Excludes Sudan, which is included in sub-Saharan Africa

quently, poor women get fistulas, and the poorer the woman the greater her likelihood of dying or suffering a catastrophic obstetric complication. Poor women do not have adequate, prompt access to emergency obstetric care. Indeed, it is commonly said that obstetric fistulas result from the combination of "obstructed labor and obstructed transportation." Thaddeus and Maine (Thaddeus and Maine 1994) have articulated the concept of three "stages of delay" that result in maternal mortality: delay in deciding to seek care, delay in arriving at a health care facility, and delay in receiving adequate care once a woman arrives at such a facility. All of these factors are present in the development of obstetric fistulas. Laboring women are often neglected in the hope that "everything will come out all right" on their own. Other women refuse to seek care for fear they will be perceived as "weak" or "cowardly," or because they are afraid of the strange social environments found in hospitals. Frequently the seriousness of the situation is not appreciated or help is not sought for fear of the family incurring high financial costs. Even if help is sought, poor roads and inadequate public transportation often result in long delays in reaching a health care facility, and even if the laboring woman makes it to a hospital, the services available there may still be inadequate to meet her needs in the face of a developing obstetric catastrophe.

The three "stages of delay" keep women on what is sometimes termed the "road to maternal death." In similar fashion it seems that there is also a "road to obstetric fistula" that begins when young girls grow up in nutritionally marginal circumstances, are married around the age of menarche, become pregnant while still adolescents, and labor at home either alone or under the care of untrained birth attendants for prolonged periods of time and without adequate access to emergency obstetrical care. In addition, many such women become victims of harmful traditional medical practices that further complicate their situation. The obstetric fistula pathway is summarized in **Figure 1.**

III. EPIDEMIOLOGY OF THE OBSTETRIC FISTULA

In industrialized countries most vesico-vaginal fistulas (VVF) are the result of radiation therapy or surgery (Latzko 1942); (Everett and Mattingly 1956); (Counsellor and Haigler 1956); (Radman 1961); (Moir 1966); (Massee, Welch et al. 1964); (Weed 1967); (Taylor and Droegemueller 1967); (Goodwin and Scardino 1980); (Enzelsberger and Gitsch 1991) (Langkilde, Pless et al. 1999). In the developing world, on the other hand, most fistulas occur from the neglect of obstetric complications. As such, they occur under very different circumstances.

To date there has never been a comprehensive worldwide survey designed to determine precisely where obstetric fistulas occur. Questions regarding the incidence and prevalence of obstetric fistulas have never been included on the standardized demographic and health surveys (DHS) that are carried out to evaluate population characteristics and overall health status in developing countries. Virtually no population-based surveys have been carried out in countries where there appears to be a high incidence and high prevalence of obstetric fistulas. Furthermore, the urinary and/or fecal incontinence that accompanies a fistula makes these women social outcasts, pushing them to the margins of society where they are ignored and further obscuring the true extent of the problem. There is a very real need for ongoing scientific research in this area. Until such work is forthcoming, we are left with only indirect means of describing the epidemic. In a short survey of available information on obstetric fistulas published by the World Health Organization in 1991 that encompassed a literature review and correspondence with over 250 individuals, institutions and organizations in developing countries, a map was created showing the distribution of countries where obstetric fistulas had been reported (**Figure 2**). The committee members, from personal experience and contact with other workers in the field, know that this map should include virtually all of Africa and south Asia, the less developed parts of Oceania, Latin America, and the Middle East; and, we suspect, the more remote regions of Central Asia and selected isolated areas of the former Soviet Union and Soviet-dominated eastern Europe. A recent survey of 9 African countries carried out by EngenderHealth for the United Nations Population Fund, has provided additional anecdotal evidence of how widespread the fistula problem is in sub-Saharan Africa (UNFPA 2003).

The true magnitude of the fistula problem worldwide is unknown, but it is clearly enormous. The situation in Nigeria may be cited as an example. Arrowsmith (1994), writing from the plateau region of central Nigeria, noted that "the local popular press estimates that the region may harbor up to 150,000 victims of vesicovaginal fistula." Harrison, also writing

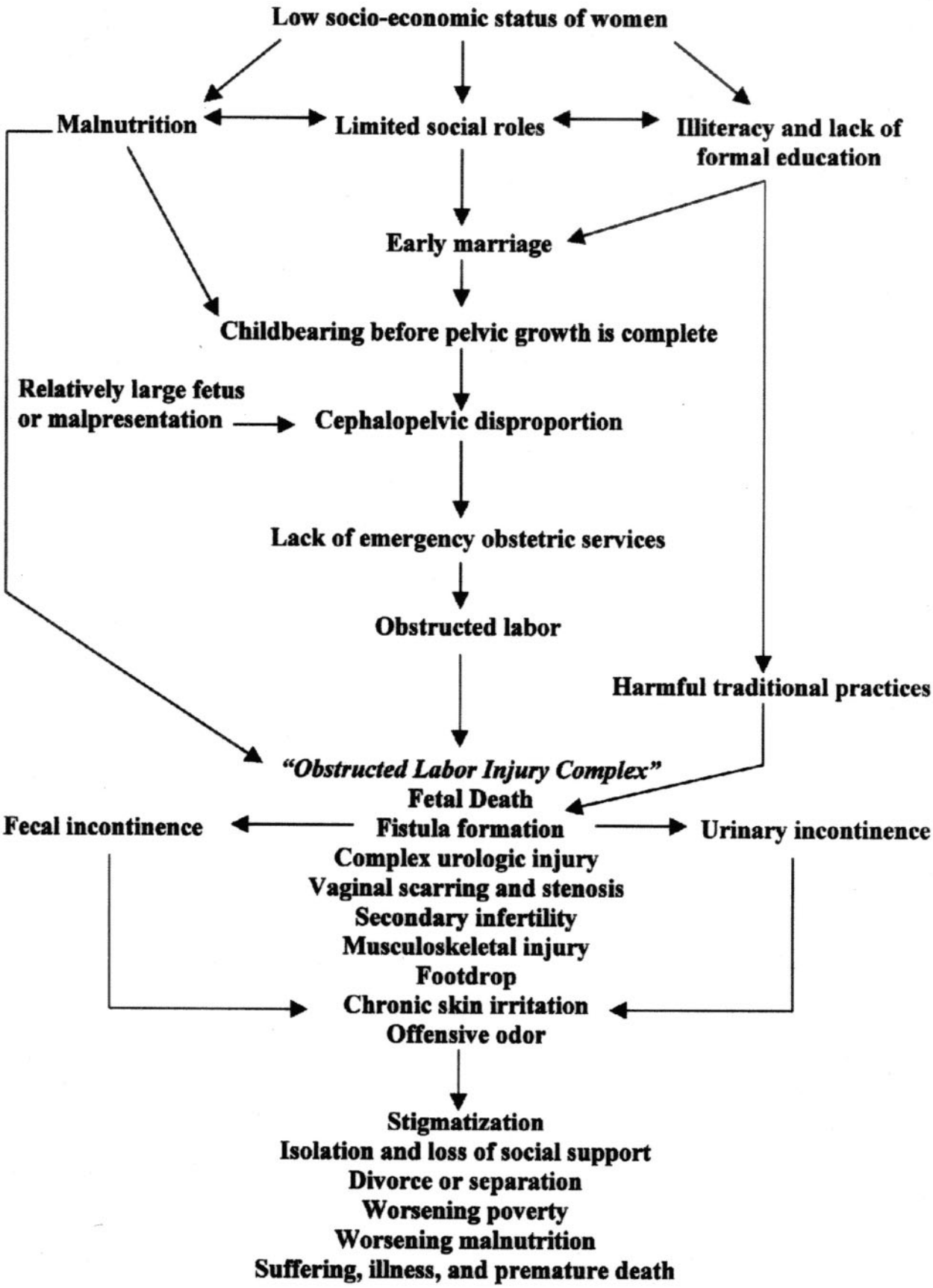

Figure 1. The Obstetric Fistula Pathway: Origins and Consequences (©Worldwide Fistula Fund, used by permission).

Figure 2. Countries from which obstetric vesico-vaginal fistulas have been reported (WHO 1991). The prevalence is actually substantially greater than this map indicates.

from northern Nigeria, reported a vesico-vaginal fistula rate of 350 cases per 100,000 deliveries at a university teaching hospital (Harrison 1985). Karshima, who has carried out village-based survey work on obstetric fistulas in the middle belt of Nigeria, suspects that there may be as many as 400,000 unrepaired fistulas in Nigeria (J. Karshima, personal communication, 2001), and the Nigerian Federal Minister for Women Affairs and Youth Development, Hajiya Aisha M.S. Ismail, has estimated the number of unrepaired vesico-vaginal fistulas in Nigeria at between 800,000 and 1,000,000 (personal communication, 2001).

The data on maternal morbidity (non-fatal obstetric complications) in developing countries are poor, but it obvious that the number of serious morbid episodes or "near misses" greatly exceeds the number of maternal deaths in the developing nations (Prual, Huguet et al. 1998). In parts of the world where a woman's lifetime risk of maternal death is high, a woman's lifetime risk of suffering serious maternal morbidity (including obstetric fistula) may be extraordinarily high. In one of the few studies that has looked at the issue of maternal morbidity, Fortney and Smith calculated the ratios of serious morbidities to maternal mortalities in Indonesia, Bangladesh, India and Egypt. For each maternal death, they calculated that there were 149, 259, 300 and 591 serious morbidities in these respective countries, and 112, 114, 24, and 67 life-threatening morbidities respectively (Fortney and Smith 1996). In the face of such sobering statistics, Danso and colleagues suggested that in regions of the world where obstructed labor is a major contributor to maternal mortality, the obstetric fistula rate may approach the maternal mortality rate (Danso, Martey et al. 1996). Other authors have reached similar conclusions (Hilton and Ward 1998; Hilton 2003).

In the absence of good population-based epidemiological studies, most information on fistulas has come from large series of patients seen at teaching hospitals or at dedicated fistula centers. Just as there are reasons to be wary of hospital-based statistics in surveys of maternal mortality (AbouZahr and Royston 1991), there are reasons to be cautious about considering hospital-based surveys of fistula patients to be representative of the over-all population of women with fistulas from obstructed labor. Answers to the following questions appear to be crucial in delineating the true extent of the fistula problem worldwide:

- Where do fistula patients come from?
- What is their social background?

- What is their educational level?
- What is the age at marriage of women who develop fistulas?
- What is the distribution of fistulas by age and parity at the time of their occurrence?
- In which pregnancy do obstetric fistulas occur?
- What proportion of women who develop fistulas had access to obstetric care, and if such care was available, why was it not used in a timely fashion?
- Where do women who develop fistulas deliver and who attends those deliveries?
- How long are these women in labor before they recognize that labor is obstructed and seek help, and how long is the delay before effective help is obtained?
- What is their marital/social status at the time of labor?
- What is the physical condition of these women when they go into labor?
- How long do women who develop fistulas wait before they undergo an attempt at surgical repair, and at what age do they present for repair?
- What is the social status of fistula victims after they develop this problem?
- Does this status change after fistula closure?
- What role do harmful traditional beliefs and practices play in the genesis of prolonged obstructed labor and fistula formation?

Although detailed answers to these questions await detailed population-based research, preliminary impressions can be obtained from surveys taken of fistula patients in hospital settings in several countries. The overall impression is that fistula patients come from poor rural areas where infrastructure development is rudimentary and access to health care—particularly access to basic midwifery and emergency obstetric services—is lacking. Fistula patients tend to be young women, many of whom married very early, of short stature, poorly educated, married to farmers or petty traders who themselves have little or no formal education. They typically have had little or no access to prenatal care, and even if they have had access to antenatal screening, they have often nonetheless delivered at home attended by family members or traditional midwives. If they have sought help from trained midwives or medical doctors, this often occurs late in labor after serious complications have already set in.

Several papers from Africa support this picture of the fistula patient. Kelly and Kwast (Kelly and Kwast 1993) reviewed a 10% sample of fistula patients seen at the Addis Ababa Fistula hospital between 1983 and 1988, by reviewing the records of every tenth patient. The mean age of these women was 22.4 years (range 9 – 45 years); 42% were less than 20 years of age, and 65% were less than 25 years of age. Of the women surveyed, 52.3% had been deserted by their husbands and 21.5% had to live by begging for food. Nearly 30% had delivered alone, and the mean duration of labor was 3.9 days (range 1-6 days).

In one review of 150 fistulas from Ghana (Danso, Martey et al. 1996), 91.5% were the result of obstructed labor and 8.5% were the result of complications of difficult gynecological surgery (22). Nearly 53% of the obstetric fistula patients were under the age of 25 and nearly 43% of patients were primigravid. Interestingly, nearly 25% of the patients had a parity of 5 or more, indicating that labor can become obstructed even in women who have previously delivered vaginally. This probably represents the tendency for birth weights to increase with successive pregnancies, as well as the effects of aging on changes in pelvic anatomy.

Information from several studies in northern Nigeria is similar. Tahzib (Tahzib 1983) reviewed records of 1,443 patients with vesico-vaginal fistulas seen in the clinics at Ahmadu Bello University in Zaria between 1969 and 1980. Delivery occurred at home in 64.4 % of these women. Among women who developed fistulas, 54.8% were under the age of 20 and only 22.7% were older than 25 years. The majority of women developed a fistula in their first pregnancy (52%), and 21.5 % of fistula patients were parity 4 or greater. Wall and colleagues (Wall, Karshima et al. 2004) analyzed 899 obstetric fistula patients from Jos, Plateau State, Nigeria and found that women with fistulas tended to have been married early (often before menarche), to be short (nearly 80% less than 150 cm tall), small (mean weight less than 44 kg), to be impoverished, poorly educated, and to come from rural agricultural families. Fistulas occurred most commonly in first pregnancies, but over 20% of fistulas occurred in women of parity 4 or greater). Two case control studies from northern Nigeria have also found fistula patients to be shorter, to be of lower socioeconomic status, and to have less education than control patients without fistulas (Ampofo, Otu et al. 1990; Onolemhemhen and Ekwempu 1999).

Virtually every paper on vesico-vaginal fistulas from developing countries demonstrates that the most

common cause of fistula formation by far is prolonged obstructed labor (Krishnan 1949; Lavery 1955; Mahfouz 1957; Naidu 1962; Aziz 1965; Yenen and Babuna 1965; Coetzee and Lithgow 1966; Bird 1967; Mustafa and Rushwan 1971; Lawson 1972; Tahzib 1983; Tahzib 1985; Waaldijk 1989; Iloabachie 1992; Kelly 1992; Arrowsmith 1994; Amr 1998; Goh 1998; Hilton and Ward 1998; Gharoro and Abedi 1999; Wall, Karshima et al. 2004) accounting for between 76% and 97% of fistulas in most large series. Vangeenderhuysen, Prual and Ould el Joud recently proposed an evaluation of the incidence of obstetric fistulas based on a population-study of severe obstetric morbidity among 19,342 women followed prospectively through pregnancy in six west African cities: Abidjan, Bamako, Niamey, Nouakchott, Ouagadougou, Saint-Louis, and a rural area in Kaolack Region, Senegal (Vangeenderhuysen, Prual et al. 2001). Only two cases of vesico-vaginal fistula occurred in this population, for an incidence of 10.3 per 100,000 deliveries. These two fistulas occurred in a rural area and no fistulas were reported from urban areas, giving a rural incidence rate of 123.9 fistulas per 100,000 deliveries. Based on an estimate of 33,748,000 deliveries per year in sub-Saharan Africa, these authors estimated that sub-Saharan Africa produced 33,451 new obstetric fistulas per year.

Another rough way of evaluating the extent of the fistula problem is to look at the proportion of labors that become obstructed and to try to extrapolate the incidence of potential fistulas from this data. Estimates for the prevalence of obstructed labor range from 0.5% - 4.7% in Nigeria (Lister 1960; Ozumba and Uchegbu 1991) to 1.7% - 2.0% for India (Sarkar and Paul 1990; Kamalajayaram 1993). The WHO prospective multicenter trial of the use of partographs in conjunction with a standardized labor management protocol found a baseline incidence of prolonged labor in 6.4% of labors at the start of the study, which fell to 3.4% after the partograph protocol was introduced (Kwast 1994). If one assumed that labor would become obstructed in approximately 2.0% of cases in Third World countries, using an estimate of 33,748,000 births per year in Africa would result in as many as 674,060 cases of obstructed labor each year. If 10% of African women with obstructed labor subsequently developed a fistula, there would be roughly 67,000 new fistulas each year in Africa alone.

In Harrison's seminal study of African obstetrics based on an analysis of 22,774 consecutive deliveries at Ahmadu Bello University Teaching Hospital in Zaria, Nigeria (Harrison 1985), there were 79 women delivered at the hospital who had or developed a vesicovaginal fistula, giving a ratio of 1 fistula for every 288 deliveries, a fistula incidence rate of 0.35%, (350 fistulas per 100,000 births). This is an astonishing figure; however, there were also 203 cases of uterine rupture. This means that a catastrophic outcome due to obstructed labor occurred in 282 deliveries, or 1.2% (1,200 such outcomes per 100,000 births). Harrison's poignant comment that "Labour is a horrifying experience for a substantial proportion of women in Northern Nigeria, as it is in many other places in the Third World" is not understated (Harrison 1985).

Other important causes of fistulas include injuries sustained during complicated gynecologic surgery performed under very difficult circumstances or fistulas resulting from complications of Cesarean delivery (often involving women who arrive at hospital already at death's door or in need of immediate emergency surgery which ends up being performed by physicians without extensive operative experience under circumstances in which they have inadequate equipment and support). Vesico-uterine fistulas, for example, are frequently the result of complications encountered during Cesarean section, rather than direct consequences of prolonged obstructed labor, although this latter presentation is by no means uncommon (Yip and Leung 1998; Jozwik and Jozwik 2000; Billmeyer, Nygaard et al. 2001; Porcario, Zicari et al. 2002). Fistulas arising as the result of surgical complications are likely to increase in frequency as access to rudimentary bioscientific medicine and surgery becomes more common in Third World countries but before smoothly functioning systems of supervision, supply, and quality control are in place (Sundari 1992). They represent an Third World version of what Moser called "diseases of medical progress:" iatrogenic complications of new innovative therapies (Moser 1956). For example, in the study of 164 fistulas reported by Danso and colleagues (Danso, Martey et al. 1996) from Kumasi, Ghana, 150 cases (91.5%) were due to obstetric complications. Of these 150 fistulas, 121 were due to prolonged obstructed labor and 24 were due to complications of cesarean section. A further 12 cases were due to complications of abdominal hysterectomy. Out of 164 fistulas, therefore, 36 (22%) were due to complications of surgery, a phenomenon that does not exist in situations where access to hospital-based medical care does not exist. A further and more dra-

matic example of this phenomenon can be found in a recent large survey of 230 vesicovaginal fistulas from Ramabothi Hospital in Thailand which were repaired between 1969 and 1997 (Kochakarn, Ratana-Olarn et al. 2000). Only 10 cases in this series were due to prolonged labor or childbirth trauma. The remaining 220 cases were due to complications of abdominal hysterectomy (164 cases), vaginal hysterectomy (23 cases), radical hysterectomy (8 cases), radiation therapy for cervical cancer (9 cases) or cervical cancer frankly invading the bladder (7 cases), suprapubic lithotomy (2 cases) and pelvic fracture (2 cases). Nearly three-quarters of these cases were referred from other hospitals and represent complications that have become more prevalent as more sophisticated medical care has reached larger proportions of the population of Thailand.

Fistulas may also be caused by accidents such as penetrating injuries to the vagina and bladder involving cattle horns or impalement by falling on a stick, infection (particularly lymphogranuloma venereum, but also diphtheria, measles, schistosomiasis, tuberculosis, infected centipede bites, etc.), foreign bodies (Arikan et. al. 2000; Fourie and Ramphal 2001), bladder calculi (Piercy, Gregory et al. 1987; Rai and Ramesh 1998), mishaps during masturbation (Ramaiah and Kumar 1998), and cervical cancer. In their series of 309 urinary fistulas treated in Pietermaritzburg, Natal, South Africa between 1954 and 1963, Coetzee and Lithgow (Coetzee and Lithgow 1966) reported 248 as resulting from obstructed labor (80%), 9 (3%) from complications of pelvic surgery, and 52 (17%) from advanced carcinoma of the cervix. Particularly troubling are fistulas caused by sexual abuse, rape, or from attempts forcibly to enlarge the vaginal introitus of child brides so that sexual relations can commence (Tahzib 1985; Sharma, Madhusudnan et al. 1987; Muleta and Williams 1999; Roy, Vaijyanath et al. 2002).

In some parts of the world, harmful traditional practices are also responsible for fistula formation. For example, in northern Nigeria, a harmful traditional practice called *gishiri*-cutting is responsible for fistula formation in 2 – 13% of cases (Tahzib 1983; Tahzib 1985; Wall 1988; Ampofo, Otu et al. 1990; Wall, Karshima et al. 2004). *Gishiri* is the Hausa word for "salt." It is often used to refer to the encrustations of salt that occur on the outsides of porous water-jars as their contents evaporate. *Gishiri* is an important ethnomedical condition in Hausa traditional medicine. The belief is that an imbalance of salty or sweet foodstuffs can cause a "film" to grow over the woman's vagina, causing a variety of gynecological complaints, the most important of these being difficult labor (Wall 1988). When this diagnosis is made, surgical treatment is often undertaken. A midwife or barber is summoned. A sharp object such as a knife, razor blade, or piece of broken glass is inserted into the vagina, and a series of random cuts is made to alleviate the postulated obstruction and "open the way" for the baby to come out. Serious infection, life-threatening hemorrhage, and fistulas frequently result from this practice. The *gishiri* fistula typically presents as a direct longitudinal slit in the bladder neck and urethra, occasionally presenting as a similar posterior injury affecting the rectum.

Another traditional practice that has been reported to produce fistulas is the insertion of caustic substances into the vagina, either as part of a traditional herbal remedy for a gynecologic condition (Lawson 1968) or as part of traditional puerperal practices to "help" the vagina return to its nulliparous state. The latter practice is a part of the traditional folk medicine of several Arab countries (Kingston 1957; Frith 1960; El-Guindi 1962). The practice was summarized by Betty Underhill in her 1964 report of 65 such cases seen at the Bahrain Government Hospital between 1957 and 1963 thus (Underhill 1964):

> "For hundreds of years it has been the custom of Arab women to pack the vagina with salt for the first week after delivery. This is popularly supposed to restore the vagina to its nulliparous state and to add to the husband's sexual pleasure. Since the practice has survived for so long it must be presumed that this desirable effect is sometimes achieved. It is certainly true, however, that in a great many cases the end results are devastating and it is these unhappy women who are driven to hospital for relief. … The substance used is crude rock salt sold in the bazaar. A piece of salt roughly the size and shape of an egg is pushed into the vagina daily for 2 to 15 days after the delivery. An additional incentive to the use of salt is its supposed antiseptic property, and some women are said to employ it between pregnancies as a contraceptive.

The immediate effect of the pessary on the hyperaemic vagina is the production of severe inflammation which goes on to ulceration. Healing of the ulcers leads to a very severe fibrosis and the vagina becomes partly or completely occluded by a substance with an almost cartilaginous texture. The walls of the upper third of the vagina are held apart by the cervix and the lower third is constantly pulled upon

by the levator ani muscle. The lax middle third is commonly the area affected by fibrosis and the patient is left with a tiny lower vagina 2 to 5 cm long, then a block or cord of fibrous tissue with an upper chamber indented by the cervix."

The fibrosis that results is extensive enough to produce obstructed labor in many cases (Fahmy 1962). Fistulas may result from either obstructed labor (Fahmy 1962) or by direct chemical action. As Naim has written, "The method of salt packing determines the site and types of the fistulae that may develop. Thus in Kuwait, where the whole vagina is packed with rock salt, combined rectovaginal and vesicovaginal fistulae develop due to rock salt being in contact with both the anterior and posterior vaginal walls. In Saudi Arabia, where pieces of rock salt are inserted high in the vagina, rectovaginal fistulae only were met with (Naim 1965)." In some cases the vagina is completely occluded, leading to the formation of a hematocolpos, dysmenorrhea, infertility and related gynecological conditions (Underhill 1964).

Much popular concern has focused recently on genital cutting practices commonly referred to as "female circumcision" or "female genital mutilation" (for example, (Aziz 1980; Abdalla 1982; Boddy 1982; El-Dareer 1982; Toubia 1994; WHO 1998; Gruenbaum 2001). While these practices should rightly be condemned by the medical community as being markedly injurious to the health of women and female children, there is absolutely no evidence in the world literature to suggest that practices of this type are the *major* cause of fistulas in developing countries. While obstetric fistulas are common in communities where various forms of female genital mutilation are practiced, the former are not usually caused directly by the latter. Rather, these two phenomena both reflect the low social status of women in these countries, which in turn is reflected by a striking underinvestment in women's reproductive health care in those countries, and a consequent lack of access to emergency obstetric care and poor general gynecologic health.

Where female genital mutilation is practiced, it contributes to the genesis of fistulas in two ways. First, as in the case of *gishiri*-cutting among the Hausa, surgical attempts to modify the female genitalia in any fashion can cause direct injury to the bladder or urethra. When such procedures are carried out without anesthetic under unsterile conditions by unskilled practitioners who do not understand female pelvic anatomy, the risk of catastrophic complications is great, and fistulas may be created by direct trauma to the urinary tract in such cases. Secondly, when large amounts of vulvar or vaginal tissue are removed as occurs in cases of infibulation ("Pharaonic circumcision") where the vaginal introitus is sewn almost completely closed or where excessive vulvar scarring has resulted from such practices, the vaginal outlet may become so narrow and constricted by dense scar tissue that the fetus cannot be expelled at the end of the second stage of labor; indeed, an anterior episiotomy is usually required in order to effect vaginal delivery in such women. If the outlet cannot be opened sufficiently to allow passage of the fetus, the resulting obstructed labor may end in a fistula. However, for this cause to be of major importance, labor would have to progress normally through the entire pelvis, become obstructed only at the outlet. The available evidence suggests that obstructed labor occurring only at the outlet is a relatively rare occurrence.

Most of the evidence suggests that in most cases where fistulas occur, labor becomes obstructed at the level of the pelvic brim or the mid-pelvis, rather than at the pelvic outlet. Further evidence for the primary importance of obstetric factors (rather than genital cutting practices) in the creation of vesicovaginal fistulas can be seen in the fact that the Hausa, who appear to have one of the highest prevalences of obstetric fistulas in the world, do not practice "female circumcision," and those fistulas that do occur due to *gishiri*-cutting constitute only a small portion of fistula cases. Comparative radiographic studies suggest that the Nigerian pelvis is considerably smaller than that of European (Welsh) women, particularly at the pelvic inlet, least significantly at the pelvic outlet (Kolawole, Adam et al. 1978).

This suggests that there are anatomic differences that predispose African women to obstructed labor (Briggs 1983). Because sexual maturity is reached before growth of the pelvic dimensions has been completed, pregnancies that occur in early adolescence are more likely to be complicated by obstructed labor than those that occur in older women (Moerman 1982). Early marriage and accompanying early pregnancy are also linked to a relatively low social status of women, tying these factors together in one more way. Many of these women also appear to suffer from chronic anemia and malnutrition, which further compromise their obstetric capabilities.

IV. THE "OBSTRUCTED LABOR INJURY COMPLEX"

Obstructed labor occurs when the presenting fetal part cannot pass through the maternal bony pelvis. The presenting part then becomes wedged against the maternal pelvic bones, compressing the soft tissues in between (**Figure 3**). The uterine contractions force the presenting part deeper into the pelvis, compressing the maternal soft tissues more forcibly. If this process is not relieved by surgical intervention, the blood supply to the entrapped soft tissues becomes compromised, ultimately resulting in tissue death and fistula formation.

The pathophysiology of obstructed labor was described clearly and succinctly by Mahfouz in 1930 (Mahfouz 1930):

> "The process by which a fistula develops after labour is the following. When labour becomes difficult, on account of disproportion between the pelvis and presenting part, or when the presentation is abnormal, the uterine contractions increase in strength and endeavour to force the presenting part through the brim. The membranes protrude unduly in the vagina, and premature rupture occurs. In consequence of early rupture and disproportion the full force of the uterine contractions is directly exerted upon the foetus and the presenting part is forced against the brim of the pelvis or gets tightly impacted therein. The vesico-vaginal septum, and the cervix if the latter is not dilated, will be tightly compressed against the back of the symphysis pubis. The uterus in such cases usually passes into a state of tonic contractions which prevents any remission in the pressure exerted on the soft parts. As a result of the continued pressure the tissues undergo necrosis and slough away. The duration of compression in such cases is usually very long, but I have seen cases in which a fistula developed after 3 hours of compression only. At about the fifth day of the puerperium the slough begins to separate and urine dribbles involuntarily into the vagina. …

The slough that develops from this pressure necrosis most commonly results in a vesico-vaginal fistula (**Figure 4**). Once this has occurred, the unfortunate woman suffers from constant, unremitting loss of urine. She can attempt to stay this flow with the use of rags or cloth, but she can never get rid of it. J. Marion Sims, who first developed a consistently successful method of fistula closure, expressed well the situation of the patient with a fistula (Sims 1852):

> "Its diagnosis is sufficiently easy. Incontinence of urine, following a tedious labour after a lapse of from one to fifteen days, will always prove its existence. But to determine the exact size, shape, and relative position of the artificial opening require some nicety of examination. The consequences of the involuntary discharge of urine are indeed painful. The vagina may become inflamed, ulcerated, encrusted with urinary calculi, and even contracted; while the vulva, nates, and thighs are more or less excoriated, being often covered with pustules having a great resemblance to those produced by tartar emetic. These pustules sometimes degenerate into sloughs, causing loss of substance, and requiring a long time to heal. The clothes and bedding of the unfortunate patient are constantly saturated with the discharge, thus exhaling a disagreeable effluvium, alike disgusting to herself and repulsive to others.

The accident, *per se,* is never fatal; but it may well be imagined that a lady of keen sensibilities so afflicted, and excluded from all social enjoyment, would prefer death. A case of this kind came under my observation a few years since, where the lady absolutely pined away and died, in consequence of her extreme mortification on ascertaining that she was hopelessly incurable."

The location and nature of the maternal injury that results from prolonged obstructed labor is a function of the force and duration of the compression that occurs, as well as the level at which labor becomes obstructed (**Figure 5**). As Mahfouz remarked (Mahfouz 1930): "The situation of the fistula depends to a great extent on the state of the cervix, when impaction and compression occur, and also on the plane of impaction. If pressure and compression occur before the cervix is pulled up over the head, the vault of the vagina and the cervical tissues may be involved in the slough. The resulting fistula will be vesico-cervico-vaginal, or uretero-vaginal, as the case may be." The location of the fistula is often determined by the particular configuration of the woman's pelvis. Thus, John St. George noted (St. George 1969):

> "Vesico-vaginal fistulae occurred more often in primigravidae (often very young) than in multiparae. Deep transverse arrest of the fetal head was commoner in primiparae with an android type of pelvis, and therefore the site of the fistula was

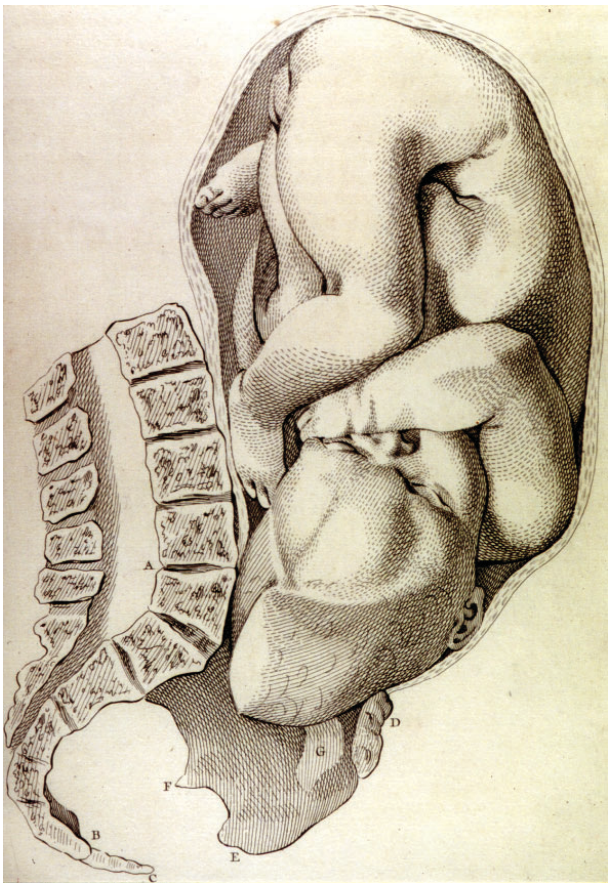

Figure 3. Obstructed labor from absolute cephalo-pelvic disproportion, from William Smellie's Sett of Anatomical Tables with Explanations, and an Abridgement of the Practice of Midwifery. London, 1754

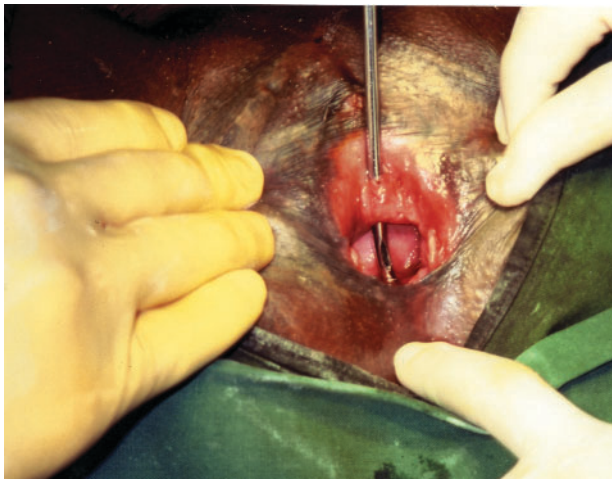

Figure 4. Typical mid-vaginal vesico-vaginal fistula from obstructed labor. A metal sound passed through the urethra can clearly be seen inside the bladder. (©Worldwide Fistula Fund, used by permission).

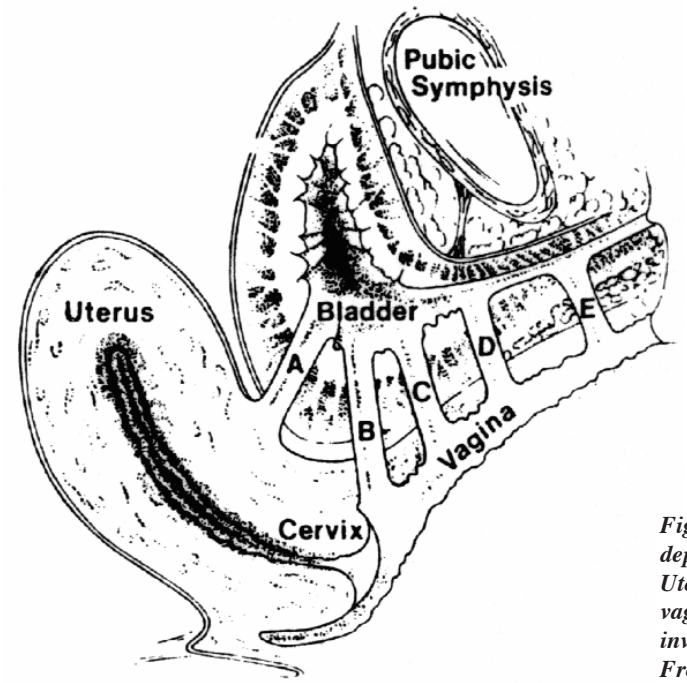

Figure 5. Types of genito-urinary fistulas. The location depends on the point at which labor becomes obstructed. A. Utero-vesical fistula. B. Cervico-vesical fistula. C. Mid-vaginal vesico-vaginal fistula. D. Vesico-vaginal fistula involving the bladder neck. E. Urethro-vaginal fistula. From Elkins (1994).

more often at the bladder neck or was juxta-urethral. Primiparae were also permitted longer labour by their folk because of their youth, and hence their fistulae were extensive. On the other hand, labour in multigravidae was often obstructed at the inlet because of a secondary flat pelvis; in these cases mid-vaginal or juxta-cervical fistulae, which were more amenable to surgery, were more common."

Many women who develop an obstetric vesico-vaginal fistula have been delivered vaginally with the use of instruments or have had an abdominal delivery by Cesarean section. As early as the 19th Century, obstetricians were often blamed for creating fistulas through the injudicious use of operative techniques. Although incompetent surgical delivery is undoubtedly responsible for some fistulas, the vast majority of patients undergoing operative delivery have been in labor for a prolonged period of time and have already suffered the ischemic insult that ultimately leads to fistula formation. The mode of delivery is therefore often unrelated to the development of the fistula that subsequently occurs (Emmet 1879). As Das and Sengupta noted in their series from India (Das and Sengupta 1969):

"Pressure necrosis is responsible to a great extent for the fistula. Most of the instrumental labour group were also prolonged labour cases and would probably have resulted in vesico-vaginal fistula even without instrumentation. Therefore, all cases were not caused by instrumental delivery as such but were due to pressure necrosis that had already existed."

The prevalence of women who have had prolonged labors and then undergone operative delivery is in part a function of increasing access to obstetric care, even if that access is not timely enough to prevent the development of a fistula. In his review of vesico-vaginal fistulas in Jordan, M.F. Amr (Amr 1998) summarized the relationship between women's health care and fistula formation with these words: "The incidence of urinary fistula reflects the standard of obstetric and gynaecological care and its availability to the population. Most fistulae are due to obstetric causes such as prolonged and obstructed labour, difficult instrumental delivery and other obstetric manipulations, and ruptured uterus."

The vast majority of women in non-industrialized countries who develop a vesico-vaginal fistula do so as the result of prolonged obstructed labor from cephalo-pelvic disproportion. The presenting fetal part is wedged into the pelvis, trapping the woman's soft tissues between two bony plates which effectively shut off the blood supply to the affected tissues. This results in extensive tissue necrosis which frequently destroys the vesico-vaginal septum and results in fistula formation; however, it is important to realize that obstructed labor produces a broad-spectrum "field injury" that may affect many parts of the pelvis. The damage that occurs is not limited to vesico-vaginal or recto-vaginal fistula formation alone. This fact is not generally appreciated by most Western doctors. Although the fistula that results is usually the dominant clinical injury, it is wrong to focus solely on the "hole in the bladder" to the exclusion of the other consequences of obstructed labor. Women who have sustained an obstetric fistula are usually injured in multiple ways, all of which impact their lives and well-being, and all of which must be considered in their care. Arrowsmith, Hamlin and Wall (Arrowsmith, Hamlin et al. 1996) have called this spectrum of injury the "obstructed labor injury complex" (**Table 2**). The understanding that one must treat the "whole person" with a fistula—-and not just her injured bladder or rectum—-is the single most important concept in fistula care. Doing this effectively requires some understanding of the multi-system consequences of prolonged obstructed labor.

1. Urologic Injury

Obstetric vesicovaginal fistulas are not caused by tearing or laceration of the bladder; rather they result from ischemic injury. Normal tissue perfusion is disrupted by compression of the soft tissues by the fetal head. This leads to ischemia, tissue death, subsequent necrosis, and fistula formation, along with varying degrees of injury to surrounding tissues which, although they have not died, nonetheless are often not completely healthy either, having suffering a non-fatal but debilitating ischemic vascular injury as well. This process has an impact at various levels throughout the urinary tract.

a) Bladder

The most familiar injury from obstructed labor is the vesicovaginal fistula. The loss of bladder tissue from pelvic ischemia during obstructed labor affects both the technique needed for, as well as the functional outcome of, fistula repair. Loss of bladder tissue is one of the main reasons why obstetric fistula repair is technically difficult. The surgeon must try to close large defects in the bladder often with only small

Table 2. Spectrum of Injuries Seen in the "Obstructed Labor Injury Complex"

Urologic Injury
Vesico-vaginal fistula
Urethro-vaginal fistula
Uretero-vaginal fistula
Utero-vesical fistula
Complex combinations of fistulas
Urethral damage, including complete urethral loss
Stress urinary incontinence
Secondary hydroureteronephrosis
Chronic pyelonephritis
Renal failure
Gynecologic Injury
Amenorrhea
Vaginal stenosis
Cervical damage, including complete cervical destruction
Secondary pelvic inflammatory disease
Secondary infertility
Gastrointestinal Injury
Rectovaginal fistula
Acquired rectal atresia
Anal sphincter incompetence
Musculoskeletal Injury
Osteitis pubis
Neurological Injury
Foot-drop
Complex neuropathic bladder dysfunction
Dermatologic Injury
Chronic excoriation of skin from maceration in urine/feces
Fetal Injury
Approximately 95% fetal case mortality rate
Social Injury
Social isolation
Divorce
Worsening poverty
Malnutrition
Depression, sometimes suicide

remnants of residual bladder tissue with which to work. Although there are as yet no basic histologic studies of the tissue surrounding obstetric fistulas, it seems clear that these tissues have themselves sustained significant damage during obstructed labor. The fistula itself develops in an area which becomes necrotic; but the tissues surrounding the fistula have also suffered varying degrees of ischemia. Although not dead, these tissues have been seriously damaged. In repairing obstetric fistulas, this unhealthy tissue surrounding the fistula must be used to close the defect—-a problem that has led many fistula surgeons to the brink of despair (**Figure 6**).

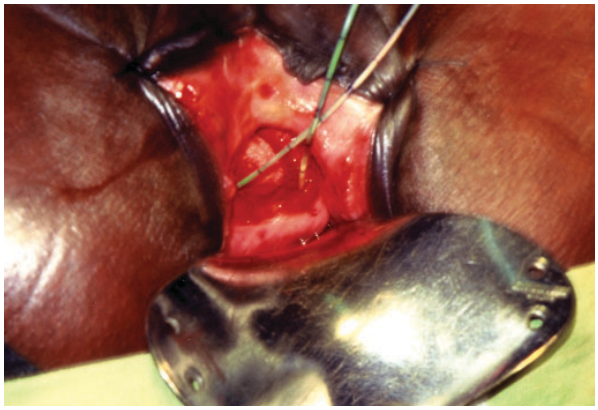

Figure 6. Large mid-vaginal vesico-vaginal fistula with scarring. The ureters, which have been catheterized for better visualization, lie directly on the margins of the fistula. (©Worldwide Fistula Fund, used by permission).

In some cases pressure necrosis may destroy virtually the entire bladder, so that if the defect can be closed at all, the afflicted woman is left with a remarkably small (30 - 50 ml) bladder that remains virtually functionless. Because most of the innervation of the bladder runs through the base and trigone, ischemic injury to these areas probably also produces an element of neuropathic bladder dysfunction. Basic scientific studies confirming this hypothesis have yet to be undertaken.

Clinical experience with fistula patients also suggests that bladder compliance may be altered by the extensive fibrotic changes that often take place. To date there have been few urodynamic studies reported on patients who have undergone successful fistula closure (Schleicher, Ojengbede et al. 1993; Carey, Goh et al. 2002). In the former study bladder compliance was not measured. In the latter study by Carey et. al., of 22 women with severe urinary incontinence after fistula closure, 9 had urodynamic stress incontinence with normal bladder compliance, 3 had

urodynamic stress incontinence with poor bladder compliance, 9 had mixed incontinence, and one had voiding difficulty with incomplete bladder emptying and overflow. There is a great need for further investigation of these issues; unfortunately, those hospitals most likely to see large numbers of patients with obstetric fistulas lack the resources for such urologic investigation. The potential use of bladder augmentation operations to restore the functional bladder capacity of such patients remains largely uninvestigated. Although there are well-established surgical techniques for bladder augmentation that can be used in the health care systems of industrialized countries, for the most part those developing countries in which fistulas are most likely to be major problems are precisely those countries in which the capacity is lacking to perform such operations safely, competently, and successfully. At least for the present, complex bladder augmentation operations (cecocystoplasty, ileocystoplasty, gastrocystoplasty, etc.) do not appear to be feasible therapies for most women with contracted bladders after obstetric fistula repair. One possible solution to this problem may lie in the use of "auto-augmentation" operations in which a portion of the detrusor muscle is removed, permitting the underlying bladder mucosa to expand, in essence creating a large bladder diverticulum (Kennelly, Gormley et al. 1994; Snow and Cartwright 1996; Leng, Blalock et al. 1999). At present the potential of these techniques in the treatment of fistula patients with small fibrotic bladders remains completely unexplored within the context of the developing world.

A number of patients with vesicovaginal fistulas develop vesical calculi (Pang, Lok et al. 2002; Dalela, Goel et al. 2003). Often these bladder stones develop in association with a foreign body in the vagina. In some cases a foreign body may have been the original cause of the fistula (such as an object used for masturbation or a container filled with traditional herbal medicines, placed in the vagina for an ostensibly therapeutic purpose). In other cases, the stone may form in association with an object that was placed into the vagina in an attempt to plug the fistula and prevent urine loss, which subsequently became stuck, eventually became calcified, and ultimately increased the overall misery of the afflicted woman. In other cases, no foreign body can be found. Frequently it is the increasing pain associated with stone formation that causes the suffering patient to present for care. In fistula cases complicated by the presence of vesical calculi, the stone is often located supratrigonally and the bladder may be able to hold at least a small amount of urine in the vicinity of the calculus (which allows for its continued growth) (Dalela, Goel et al. 2003). Removal of the stone (usually at a separate operation) is a pre-requisite for successful fistula closure in such cases. After stone removal, the bladder should be allowed to heal for several months prior to attempted fistula closure. Frequent irrigation of the bladder after the stone has been removed may improve healing of the injured tissues prior to fistula closure, but there are insufficient data to substantiate this proposal except in anecdeotal cases.

b) Urethra

The ischemic changes produced by obstructed labor often have a devastating impact on urethral function. The great Egyptian fistula surgeon Naguib Mahfouz was well aware of this problem. As he wrote in 1930 (Mahfouz 1930):

> I have carefully examined 100 patients suffering from what was termed vesico-vaginal fistula during the last 10 years. I found by careful examination and measurement of the urethra that the sloughing which ultimately led to the formation of the fistulae had in more than half the cases involved from one-third to half of the urethra. This is not to be wondered at, since in most cases of obstructed delivery in which the bladder is pulled up above the brim of the pelvis the urethra is pulled up with it. If the seat of obstruction happens to be at the brim of the pelvis, the neck of the bladder and a small portion of the upper third of the urethra seldom escapes compression. In cases in which the presenting part is impacted in the cavity of the pelvis, or detained at the outlet, the entire urethral canal will be lying in the plane of compression. In some of these cases the urethra sloughs away completely."

The finest centers in the world report fistula closure rates in excess of 90%, yet many patients who have had a successful fistula repair continue to have severe urinary incontinence. Although the bladder defect has been closed successfully, many patients have defective, injured urethras which are often foreshortened, fibrotic, functionless "drainpipes" densely bound in scar tissue. Such patients may remain almost totally wet even when their fistulas have been closed. Perhaps as many as 30% of fistula patients have some element of persistent stress incontinence after repair (Hassim and Lucas 1974; Hudson, Hen-

rickse et al. 1975; Schleicher, Ojengbede et al. 1993; Browning 2004). One small study of 55 patients with obstetric fistulas who had undergone successful closure of their fistulas found that 30 women (55%) had persistent urinary incontinence. Urodynamic testing demonstrated genuine stress incontinence in 17 women (31%), detrusor over-activity in 2 (4%) and mixed incontinence due to both conditions in 11 (20%) (Murray, Goh et al. 2002). The development of successful techniques for dealing with persistent transurethral incontinence after successful fistula closure remains an unmet challenge in fistula surgery (Hilton, Ward et al. 1998; Murray, Goh et al. 2002; Browning 2004).

Loss of the urethra traditionally has been the most feared form of obstetric fistula. Complete urethral loss occurs in about 5% of fistula patients, with about 30% of fistula patients sustaining partial urethral injury. Mahfouz stated (Mahfouz 1930) that fistulas "in which the whole urethra has sloughed" are **"**the most troublesome of all.**"** The experience of subsequent surgeons seems to bear this out. In a 1980 series based on 1,789 fistula patients, Sister Ann Ward reported that only 26 cases were inoperable; but in all 26 urethral loss was present (Ward 1980). In urethral fistula repair, the surviving tissues must be reassembled not just as a tube, but as a supple, functional organ that serves both as a conduit for urine as well as a "gatekeeper" ensuring that the passage of urine occurs only at socially appropriate times and places. There are no comparative surgical studies that evaluate differing techniques of urethral reconstruction in patients with obstetric fistulas. Work of this kind is badly needed.

c) Ureters

Ureterovaginal fistulas from direct injury to the distal ureter during obstructed labor are uncommon, comprising only about 1% of fistula cases. Depending on the amount of tissue that is lost at the bladder base, the ureteral orifices can be found in bizarre locations, ranging from the lateral vaginal walls all the way up to the level of the vesicourethral junction and the pubic arch (Figure 6). Aberrant ureteral locations of this kind can easily be missed on clinical examination and are one cause of persistent incontinence after otherwise "successful" fistula closure. Standard urological tools such as ureteral stents are usually not available in hospitals in the developing world, and most of the surgeons who work in such hospitals are not trained in "urologic" techniques such as ureteral reimplantation (Waaldijk 1995).

d) Kidneys

The incidence of secondary injury to the upper urinary tract in fistula patients has received little study, but this phenomenon appears to be clinically important. Clinical experience suggests that renal failure is a common cause of death in women with obstetric fistulas. Upper tract damage could result from chronic ascending infection, obstruction from distal ureteral scarring, or even from reflux in very young patients. Lagundoye et al (Lagundoye, Bell et al. 1976) found that 49% of fistula patients had some abnormality of the kidneys when intravenous urograms were performed. Most of the pathology that was detected consisted of minor calyceal blunting, but 34% of patients had hydroureter, 9.7% had ureteral deviation, four patients had bladder stones, and 10 patients had a non-functioning kidney. In the developing world, hospitals typically have neither the laboratory capability to detect azotemia, nor the radiographic facilities to diagnose hydroureteronephrosis. It is clear, however, that secondary damage to the kidneys is common in patients with obstetric fistulas.

2. Gynecologic Injury

a) Vagina

An impaction of the fetal head serious enough to cause ischemic injury to the bladder will also cause ischemic injury to the vagina, which is likewise trapped between the two bony surfaces. These injured areas heal with varying degrees of scarring. A small sonographic study by Adetiloye and Dare (Adetiloye and Dare 2000) detected fibrotic changes in 32% of fistula patients and minor vaginal wall fibrosis in another 36%. Vaginal injuries in fistula patients exist along a spectrum that includes only small focal bands of scar tissue on one end all the way to virtual obliteration of the vaginal cavity on the other. Roughly 30% of fistula patients require some form of vaginoplasty at the time of fistula repair.

The degree of vaginal injury has several important implications. In the first instance, severe vaginal injury results in loss of substantial portions of the vagina. In many instances the scarring is such that vaginal intercourse is simply not possible. There is virtually no information available on the sexual functioning of fistula patients, yet this is obviously an important concern in healthy marital relationships and undoubtedly contributes to the high rates of separation and divorce that appear common among these women. Surgical repair of fistulas in women

with extensive vaginal scarring often requires the use of flaps and tissue grafts in order to close the fistula. Little work has been done to assess whether nor not sexual function normalizes in women who have had such operations. The presence of scarring that requires the use of plastic surgical techniques of this kind markedly reduces the effectiveness of surgical repair when fistula closure is attempted by surgeons who lack experience in reconstructive gynecologic surgery. Although several papers have described various techniques for vaginoplasty that may be required in fistula patients (Dick and Strover 1971; Hoskins, Park et al. 1984; Margolis, Elkins et al. 1994), there is a pressing need to investigate the role of vaginal plastic surgery at the time of fistula repair and to evaluate subsequent sexual functioning in patients who require surgery of this kind.

Vaginal scarring impacts more than just sexual functioning. The presence of vaginal scarring appears to be an important prognostic factor in determining the likelihood both of successful fistula closure, and also for the development of debilitating urinary stress incontinence after otherwise successful fistula repair. In one unpublished series of 26 fistula patients with severe vaginal scarring, 57.7 percent suffered from stress incontinence after fistula repair and 23.5 percent had a persistent or recurrent fistula. This would compare to an expected stress incontinence rate of around 26% and a failed fistula closure rate of about 7% in the overall population of fistula patients (Arrowsmith, personal communication). As Lawson Tait remarked in his book, *Diseases of Women* (Tait 1879): "One case, which I utterly failed to improve in any way, had the whole vagina destroyed by sloughing, so that the rectum, ureters, and uterus opened into a common cloaca about two inches deep, with walls of cartilaginous hardness. In such cases the damage is nearly always very extensive and very difficult to remedy." Kelly and Kwast have also reported worsening surgical outcome in fistula patients who have vaginal scarring than in those without such findings (Kelly and Kwast 1993).

b) Cervix, Uterus, and Future Reproductive Performance

From an obstetric point of view, timely termination of obstructed labor requires operative intervention, most often by cesarean delivery. When timely access to cesarean section is not available, prolonged obstructed labor results in a high rate of uterine rupture, usually with catastrophic consequences for both mother and child. For example, Ekele and co-workers reported one uterine rupture for every 79 deliveries in Sokoto, Nigeria, an impoverished rural area with poor obstetric services (Ekele, Audu et al. 2000). Cesarean delivery in such cases is often lifesaving, but in some cases it may also be implicated in the formation of a vesico-uterine fistula (Yip and Leung 1998; Billmeyer, Nygaard et al. 2001; Porcario, Zicari et al. 2002). Vesico-uterine fistulas can present in different ways, depending on their location, size, and the degree of patency of the endocervical canal. The least troublesome vesico-uterine fistulas do not result in incontinence, but are characterized by the absence of vaginal menstruation in the presence of cyclic hematuria ("menouria" or "Youssef's syndrome"), whereby the menstrual flow exits exclusively through the urinary tract (Youssef 1957; Arrowsmith, Hamlin et al. 1996; Jozwik and Jozwik 2000). Other vesico-uterine fistulas may be associated with various combinations of altered menstruation and either periodic or continuous incontinence. The finding most characteristic of a uterovesical fistulas is demonstrable loss of urine through the cervix (a finding that also occurs with vesicocervical fistulas). It should be pointed out that both uterovesical and vesicocervical fistulas can also result from prolonged obstructed labor in the absence of operative intervetion.

Many patients sustain severe cervical damage as well as vaginal injury in the course of obstructed labor. When fistula patients are examined, a completely normal cervix is rarely seen. The presence of cervical injury would also help explain the apparently high prevalence of pelvic inflammatory disease encountered among these patients. In the worst cases, prolonged obstructed labor may result in complete cervical destruction, leaving the patient with no identifiable cervical tissue at all. Unfortunately, detailed descriptions of the condition of the cervix have not been included in the series of fistulas published to date. Since cervical competence is such an important factor in future reproductive performance, this is yet another clinical area that demands further study.

A review of the menstrual histories of 998 patients with obstetric fistulas in Ethiopia (Arrowsmith, Hamlin et al. 1996) showed 63.1 percent were amenorrheic. Other studies have shown amenorrhea rates from 25% to 44% (Aimakhu 1974; Bieler and Schnabel 1976; Evoh and Akinla 1978). Many of these patients undoubtedly have hypothalamic or pituitary dysfunction (Bieler and Schnabel 1976). While the high incidence of amenorrhea in VVF patients is widely recognized, only one unpublished study has

been done to look specifically at uterine pathology in the VVF population. Dosu Ojengbede of the University of Ibadan (personal communication) performed hysteroscopy on fistula patients in Nigeria and found that intrauterine scarring and Asherman's syndrome are common. The combination of widespread amenorrhea, vaginal scarring, and cervical destruction leads to a tremendous problem of secondary infertility among these patients. To date, there have been no serious scientific efforts to explore treatment of cervical and uterine damage in VVF patients.

Subsequent reproductive performance of women who have had an obstetric vesicovaginal fistula has been analyzed in a few articles (Naidu and Krishna 1963; Aimakhu 1974; Evoh and Akinla 1978; Emembolu 1992). Emembolu analyzed the subsequent reproductive performance of 155 fistula patients delivered at Ahmadu Bello University Teaching Hospital in Zaria, Nigeria, between January 1986 and December, 1990 (Emembolu 1992). This series included pregnancies in 75 women who became pregnant after successful fistula closure and 80 women who became pregnant while still afflicted with an unrepaired fistula that had occurred in a previous pregnancy. The data presented do not allow one to determine the subsequent fertility rates of women who develop a fistula, but clearly indicate that women can, and do, become pregnant after sustaining an obstetric fistula. The proportion of booked pregnancies receiving antenatal care was higher in the repaired group (73%) than in the unrepaired group (51%), and reproductive performance was better (but still dismal) in those patients who had had a fistula repair. Of the 69 patients whose fistulas had been repaired, there was a recurrence in 8 (11.6%), and among those undergoing a trial of vaginal delivery, the fistula recurrence rate was nearly 27%. In women with pre-existing, unrepaired fistulas who became pregnant but who did not register for prenatal care in the subsequent pregnancy, maternal mortality and morbidity in those pregnancies was high, reflecting continuation of the conditions that let to fistula formation in the first place (Emembolu 1992):

"Mrs. A.A., a 25-year-old unbooked para 1+0 (neonatal death) whose VVF was as yet unrepaired was admitted at 40 weeks gestation in the second stage of labor. She had been in labor at home for over 20 h before admission. Vaginal examination revealed that the vagina was markedly stenosed and the patient in advanced obstructed labor with an intrauterine fetal death. At cesarean section, the uterus was found to have ruptured. The macerated female fetus weighting 2800 g was delivered and the patient had a repair of the uterus with bilateral tubal ligation. She however died on the sixth post-operative day of persistent anemia and overwhelming infection due to *Klebsiella* species.

Mrs. M.A., a 28-year old unbooked para 1+0 (stillbirth) who had a residual vesico-vaginal fistula was admitted in labor at 34 weeks gestation. She had been in labor at home for about 19 h prior to admission in the second stage of labor. Vaginal examination revealed marked vaginal stenosis admitting only one finger. A diagnosis of advanced obstructed labor with fetal distress was made. At cesarean section, a severely asphyxiated female baby weighing 2200 g with Apgar score of 1 and 2 at 1 and 5 min was delivered. The baby died within 30 min of delivery. The mother subsequently developed post-partum eclampsia with septicemia from *Staphylococcus aureus* and died on the fourth post-operative day.

The commonest maternal morbidity, excluding recurrence of VVF, was hemorrhage requiring blood transfusion in 35 patients (27.3%). Others included ruptured uterus in 3 unbooked patients whose fistulae had not been repaired, bladder injury at cesarean section in 1.6% and acute renal failure in 0.8%. The maternal complications occurred more frequently in the patients whose fistulae had not been repaired and who were also unbooked."

The largest series is that of Aimakhu, who analyzed subsequent reproductive performance in 246 women who underwent successful fistula closure at University College Hospital in Ibadan, Nigeria, between 1957 and 1966 (Aimakhu 1974). Only 48 patients became pregnant following fistula repair with a total of 65 pregnancies. All but 6 of these were managed at University College Hospital. Five patients had aborted prior to the 16^{th} week of gestation, leaving only 60 viable pregnancies. The plan was to perform elective Cesarean section on all patients who became pregnant after fistula surgery, but only 49 Cesarean operations were carried out. The results of the vaginal deliveries were not encouraging. Aimakhu summarized the results in this fashion (Aimakhu 1974):

"Of the eight vaginal deliveries, six were our booked patients, and they were all admitted in the second stage of labor; one patient had in fact delivered the first of her twins before arrival. There were no mater-

nal deaths among these six patients and there was no reopening of the fistulae after delivery. Five of the seven babies survived. The seventh patient with vaginal delivery had an instrumental vaginal delivery elsewhere. The baby was stillborn and the fistula recurred. At the beginning of the repair of the new fistula in our unit, this patient died from cardiac arrest. The eighth patient with vaginal delivery sustained her first fistula in her first delivery in 1952. This was successfully repaired elsewhere 4 years later. In 1962 she was allowed a vaginal delivery in another hospital. The baby was stillborn and the fistula recurred. Following another successful repair of the fistula she became pregnant again. She defaulted from a cesarean section offered her in our unit. She delivered at home another stillborn baby and the fistula was again reopened."

Patients who underwent cesarean delivery fared better. There were 49 fetuses delivered and 47 survived. There was no recurrent fistula among women previously repaired who became pregnant and had a subsequent cesarean section. There was one maternal death from pulmonary embolism in a woman who underwent a emergency delivery at 32 weeks gestation due to a prolapsed fetal umbilical cord.

Figure 7. Large combined vesicovaginal and rectovaginal fistula. (©Worldwide Fistula Fund, used by permission).

3. The Recto-Vaginal Fistula

Rectovaginal fistulas appear to be significantly less common than vesico-vaginal fistulas. In case series of patients presenting with vesico-vaginal fistulas, between 6% and 24%% have a combined recto-vaginal and vesico-vaginal fistula (**Figure 7**) (Emmet 1868; Naidu 1962; Aziz 1965; Coetzee and Lithgow 1966; Bird 1967; Mustafa and Rushwan 1971; Ashworth 1973; Tahzib 1983; Tahzib 1985; Waaldijk 1989; Arrowsmith 1994; Amr 1998; Hilton and Ward 1998; Wall, Karshima et al. 2004). In most series, isolated recto-vaginal fistulas are less common than combined fistulas. Indeed, most series do not even mention isolated recto-vaginal fistulas as a clinical phenomenon. In a series of patients from Turkey reported by Yenen and Babuna (Yenen and Babuna 1965), 7.1% had recto-vaginal fistulas and 6.5% had "combined" fistulas. From the report it is not clear if this latter figure was comprised solely of recto-vaginal and vesico-vaginal fistulas, or if it included other combinations of urinary tract fistulas as well (vesico-cervico-vaginal, urethro-vaginal, etc.). Kelly and Kwast (Kelly and Kwast 1993), reporting data from the Addis Ababa Fistula Hospital, noted a 15.2% prevalence of combined fistulas, and a 6.8% prevalence of isolated rectovaginal fistulas in that population. Ethiopia appears to have one of the highest rates of recto-vaginal fistulas reported in the literature. Whether this relates to specific obstetric characteristics of the Ethiopian population or whether this relates to other social factors—-such as the cases of rape and sexual abuse of young Ethiopian girls reported by Muleta and Williams (Muleta and Williams 1999)—is unclear.

Since the pubic symphysis poses an obstruction to delivery through the anterior pelvis, in normal birth mechanics the fetal head is normally forced posteriorly towards the rectum, anus, and perineum at the end of the second stage of labor. In non-obstructed labor, direct laceration of the perineum is not uncommon, occasionally resulting in a complete perineal tear with complete disruption of the anal sphincter. If this is not repaired, a complete perineal tear with sphincter disruption can create a recto-vaginal fistula at the anal outlet (Radman, Al-Suleiman et al. 2003). This mechanism of fistula formation seems more likely to account for low recto-vaginal fistulas, whereas recto-vaginal fistulas higher in the pelvis would seem more likely to be caused by direct tissue compression from obstructed labor.

As Mahfouz noted in 1938 (Mahfouz 1938):

"The process by which faecal fistula forms after labour differs greatly from that which leads to the formation of a urinary fistula. Sloughing, due to pressure-necrosis produced by impaction of the presenting part, which accounts for the overwhelming majority of urinary fistulae, is seldom the cause of faecal fistula. It accounted for 2 cases only in my series of 75. The majority of the remaining cases were the result of a complete tear of perineum which extended into the recto-vaginal septum. The lacerated edges of the perineum united spontaneously in the lower part where the tissues were fleshy, but remained ununited at the upper end where tissues were thin. This results in a permanent communication between the vagina and rectum at the upper end of the healed tear."

In Das and Sengupta's series of 135 obstetric fistulas from India, there were 12 patients with recto-vaginal fistulas, 6 patients with complete perineal tears, 1 patient with both a recto-vaginal fistula and a complete perineal laceration, and 1 patient with a recto-vaginal fistula as well as a fistula-in-ano, giving a posterior fistula rate of 20/135 or 14.8%.

Because recto-vaginal fistulas appear to be less common than genito-urinary fistulas in the developing world, less attention has been paid to describing techniques for their repair in this setting. Mahfouz recommended different approaches to recto-vaginal fistulas, depending on their location (Mahfouz 1938).

"The methods of treatment of faecal fistula differ according to their site. If the fistula is situated at the vaginal outlet, incorporated in or lying immediately above an incompletely healed perineal tear, the perineum should be cut through. In other words, the recto-vaginal fistula is converted into a complete tear of the perineum and is dealt with as such. The vaginal and rectal walls are next separated from one another by a transverse incision. This separation should be carried well above the upper edge of the fistula. The rent in the rectum is now carefully sutured with catgut. The sutures should not pierce the mucous membrane of the gut. The next step is to unite the levator ani muscles in the middle line so that a thick mass of tissue is interposed between the lines of sutures in the vagina and rectum respectively. The cut ends of the sphincter should now be very carefully brought together and the perineum reconstructed in the usual manner.

In dealing with rectal fistulae situated at a distance from the perineum the latter should not be cut through. These fistulae should be dealt with by a flap-splitting operation performed on the same principles employed in operating on urinary fistulae. The separation of the rectal from the vaginal wall should be carried until a point well beyond the upper and lower limits of the fistulae. In rectal fistulae this separation can be effected more easily, and much more widely, than separation of the bladder in urinary fistulae."

These general principles still prevail. For example, Arrowsmith (Arrowsmith 1994) recommended oral cathartics and cleansing enemas (where the fistulas were small enough to allow the patient to retain some enema fluid), followed by wide mobilization of the fistula, a two-layered rectal closure, with perineal reconstruction and the use of Martius bulbocavernosus fat flaps for large defects. These general principles have also been endorsed by Hudson (Hudson 1970).

More problematic is the very high recto-vaginal fistula, where the fistula occurs in the upper vagina (Eden 1914; Mahfouz 1934; Lawson 1972; Bentley 1973). Such cases are particularly troublesome if the vagina is very stenotic or the fistula is fixed and tethered in such a manner as to prevent its being dissected free and brought down low enough so that a vaginal repair can be attempted. Extremely skilled fistula surgeons may still be able to repair such fistulas transvaginally, but in many cases the route of repair for these injuries may need to be transabdominal. Before attempting to repair a rectovaginal fistula using a transabdominal technique, the patient should always have a thorough bowel preparation and undergo a temporary transverse colostomy. In Hudson's series of 88 high rectovaginal fistulas, successful closure was significantly more likely if a colostomy had been performed prior to attempted fistula closure (Hudson 1970). Each abdominal repair operation is likely to be different, due to the comparative rarity of the high rectovaginal obstetric fistula and the variable severity and extent of the concurrent pathology that is likely to accompany it, but in general the surgeon should attempt to separate the vagina from the rectum, close the rectum in multiple layers, interpose a pedicled graft of omentum between the rectum and the vagina and, where possible, close the vagina separately (Bentley 1973).

Clinical experience suggests that "double fistulas" (combined vesico-vaginal and recto-vaginal fistulas) are more difficult to repair than solitary rectovaginal

fistulas (Hudson 1970). In patients with double fistulas, the amount of normal tissue available for use as vaginal flaps is often very limited, and the reduction in vaginal space that occurs after successful closure of a double fistula can be formidable. The presence of a concurrent rectovaginal fistula also decreases the likelihood of successful closure of a vesicovaginal fistula.

Rectovaginal fistula repair presents special problems for the fistula surgeon, particularly in cases where the fistula is high or complex. Many gynecologic surgeons may not be comfortable performing a colostomy, let alone more complex colon and rectal operations such as a colo-anal pull-through procedure. Colostomy surgery requires access to more sophisticated anesthesia capability than vaginal fistula repair, and in many cultures a colostomy is no more acceptable than a rectovaginal fistula, particularly as useable colostomy appliances are often difficult or impossible for most fistula patients to obtain. From a research perspective, the issue of anal sphincter function in obstetric fistula patients remains virtually unaddressed, both with regard to the presence of injuries in women who only have a vesico-vaginal fistula, as well as in patients who have had successful recto-vaginal fistula repair. One recent study of 55 patients with obstetric fistulas from Ethiopia found 21 women (38%) had symptoms of altered fecal control after repair, including 13 (24%) who had problems with both urinary and anal control (Murray, Goh et al. 2002). Of these 21 patients, 3 had undergone repair of a combined vesicovaginal and rectovaginal fistula, and 18 had undergone vesicovaginal fistula repair alone.

4. Orthopedic trauma

Ischemic injury from obstructed labor not only affects pelvic organs, but also the pelvis itself. These changes are most pronounced in the pubic symphysis. The normal radiography of the symphysis pubis has been described in detail by Vix and Ryu (Vix and Ryu 1971). In obstructed labor, the pubic bones are often directly involved as they form one side of the bony vise in which the vulnerable soft tissues are trapped. In fistulas where large amounts of bladder tissue are lost, the periosteum of the pubic arch can often be palpated directly through the fistula defect. It is these cases in which ischemic damage to the pubic bones is most likely to be demonstrable. In a study of 312 Nigerian women with obstetric vesicovaginal fistulas Cockshott (Cockshott 1973) detected bony abnormalities in plain pelvic radiographs in 32 percent of these patients. The findings included bone resorption, marginal fractures and bone spurs, bony obliteration of the symphysis, and wide (>1 cm) symphyseal separation. Most of these changes appear to be the result of avascular necrosis of the pubic symphysis. Their long-term significance remains uncertain and further study is required.

5. Neurologic injury

Another tragic injury associated with obstetric fistula formation is foot-drop (Waaldijk and Elkins 1994). The relationship between difficult labor and neurological injury has been known for centuries, and the condition was traditionally called “obstetric palsy” (Sinclair 1952). Women with this condition are unable to dorsiflex the foot and therefore walk with a serious limp, dragging their injured foot, and using a stick for support (**Figure 8**). Sinclair’s paper on maternal obstetric palsy in South Africa (Sinclair 1952), made the comment that “There are no records of this lesion associated with vaginal fistulae, where there has been prolonged pressure by the foetal skull in the lower part of the pelvis.” This statement is clearly wrong. In Waaldijk and Elkins’ review of 947 fistula patients, nearly 65% of those studied prospectively had evidence of peroneal injury either by history or physical examination (Waaldijk and Elkins 1994). The prevalence of clinical footdrop among patients seen at the Addis Ababa Fistula Hospital is about 20% (Arrowsmith, Hamlin et al. 1996). Various theories have been proposed for the etiology of this condition. In general clinical series of peroneal nerve palsy, the most common etiologies

Figure 8. Fistula patient with foot-drop, manifested by an inability to dorsiflex the foot. In particular note the trauma to the toes, as well as the constant puddle of urine in which she walks. (©Worldwide Fistula Fund, used by permission).

appear to be direct trauma from ankle inversion, fractures of the hip, femur, fibula or tibia; knee injuries, alcoholic neuropathies, and a variety of miscellaneous or idiopathic causes. In obstetric patients the lesion most likely develops from one of three causes: prolapse of an intravertebral disk, pressure from the fetal head on the lumbo-sacral nerve trunk in the pelvis leading to direct compression of the peroneal nerve, or direct trauma to the peroneal nerve from prolonged squatting and pushing in the second stage of labor (Sinclair 1952; Reif 1988; Colachis, Pease et al. 1994). Of the three possible etiologies, the last seems the most likely; however, to date no one has performed electromyographic studies of the lower extremities in fistula patients with foot-drop to evaluate the neurophysiological abnormalities that are present. Foot-drop has also been associated with trauma sustained in difficult forceps deliveries, particularly mid-pelvic rotations, but again, as others have emphasized "The peripheral nerve lesion following instrumental delivery may have developed in any case and forceps were but incidental or at the most a precipitating factor in border-line cases" (Sinclair 1952). The prognosis for recovery from this injury is unclear, as there are no proper prospective studies of women who have developed this condition. Waaldijk and Elkins suggest that most patients recover some or all of their nerve function spontaneously within two years of the injury (Waaldijk and Elkins 1994); however 13% showed persistent signs of nerve trauma. In some cases the affected women are almost completely crippled from bilateral lesions and suffer tremendously from the additional burden imposed by immobility on someone who already suffers from intractable urinary incontinence. Physiotherapy and the use of posterior splints improve the condition of some patients. Others may require surgical intervention: the use of posterior tibialis tendon transfer is a well-established procedure for patients with foot-drop from other causes (such as leprosy), and it may be that this method will be useful in treating women with unresponsive obstetric palsy as well (Hall 1977; Richard 1989).

6. Dermatologic injury

The condition of the skin, which is in constant, unremitting contact with a stream of urine or feces, is one of the most bothersome problems for the fistula patient (**Figure 9**). The problems thus encountered have been eloquently described since the early days of fistula surgery. The great American gynecologist Thomas Addis Emmett summarized the clinical situation in 1868 (Emmet 1868):

Figure 9. Encrustation of the vulva with uric acid salts, as the result of the constant trickle of urine from the fistula. (©Worldwide Fistula Fund, used by permission).

"Unless the greatest care has been given to cleanliness, the sufferer, in a few weeks after receiving the injury, becomes a most loathsome object. From the irritation of the urine, the external organs of generation become excoriated and oedematous, with the same condition extending over the buttocks and down the thighs. The labia are frequently the seat of deep ulcerations and occasionally of abscesses. The mucous membrane of the vagina is in part lost, and the abraded surface rapidly becomes covered at every point with a sabulous or offensive phosphate deposit from the urine. If the loss of tissue has been extensive, the inverted posterior wall of the bladder protrudes in a semi-strangulated condition, more or less incrusted with the same deposit, and bleeding readily. This deposit will frequently accumulate to such an extent in the vagina that the sufferer becomes unable to walk or even to stand upright, without the greatest agony.

The deposit must be carefully removed as far as possible by means of a soft sponge, and the raw surface brushed over with a weak solution of nitrate of silver. If, at any point, it cannot be at first removed without causing too much bleeding, the deposit itself must be treated in the same manner, or coated with the solid stick. Warm stiz-baths add greatly to the comfort of the sufferer. The vagina must be washed out several times a day with a large quantity of tepid water. After bathing, it is best for the patient to protect herself by freely anointing the outlet of the vagina and the neighboring parts with any simple ointment.

She must be instructed to wash her napkins thoroughly when saturated with urine, and not simply to dry them for after-use. Time, and increased comfort of the patient, are gained by judicious attention to such details.

About every fifth day, the excoriated surfaces yet unhealed should be protected with the solution of nitrate of silver; and it is frequently necessary to pursue the same general course for many weeks, before the parts can be brought into a perfectly healthy condition. This point is not reached until not only the vaginal wall, but also the hypertrophied and indurated edges of the fistula, have attained a natural color and density. This is the secret of success; but the necessity is rarely appreciated; without it, the most skillfully performed operation is almost certain to fail.

When the proper condition has been brought about, the surgeon may then be able to decide upon some definite plan of procedure for the closing of the fistula.

Further work remains to be done on determining the optimal regimen of skin care for patients with fistulas within the context of developing countries. It seems clear that efforts of this kind will produce marked improvements in the reduction of patient suffering, even before fistula closure is undertaken.

7. Social consequences of prolonged obstructed labor

Although physicians tend to think in terms of clinically definable injuries, much of the suffering that fistula patients endure is a result of the social consequences of their condition. It is vitally important to understand the social context in which these injuries occur (Wall 1998; Wall 2002). Although there is no such thing as a monolithic "African culture", in many areas where fistulas are endemic there appear to be recurring patterns that allow for some general observations to be made regarding the position of women. In countries where there are high fistula rates, women generally have a lower social status than men. Often a woman's role in family life centers around a strong obligation to satisfy the sexual needs of her husband and to provide him with offspring (preferably male), and both men and women are dependent on their children for care when they become old. In many African societies, women are often called upon to perform heavy manual labor, tending the fields, carrying water and firewood. Religion—be it Islam, Christianity, or a traditional African religion—-also plays a more central role in day-to-day life than is common in Western countries. Each of these areas of human life is affected in a profoundly negative way by the injuries sustained in obstructed labor.

a) Marriage and Family Life

In societies where obstetric fistulas are still prevalent, a woman's role in life is defined almost exclusively in terms of marriage, childbearing, and the family life that results (Wall 1988; Wall 1998). Because most women in these societies appear to accept this role at present, the inability to have children or to satisfy her husband's sexual needs may diminish her own sense of self worth. Vaginal injuries often make intercourse impossible, and the constant stream of urine makes it otherwise unpleasant. As members of agrarian societies, women are often expected to contribute long hours of hard labor working on the family farm. Foot drop and associated pelvic injuries may make the satisfactory performance of these tasks impossible. The woman, formerly a productive laborer, then becomes an economic burden as an invalid. The combination of all of these factors often leads to a gradual disintegration of the marriage over time, which then ends with complete rupture of the relationship. The existing data suggest that large numbers of fistula patients become divorced or separated from their husbands, particularly when it becomes evident that their condition is chronic, rather than transient. Unpublished data from Ethiopia suggest that almost 50 percent of VVF victims are divorced or separated (S.D. Arrowsmith, personal communication). Murphy's research documented similar findings in northern Nigeria (Murphy 1981). In analyzing 899 fistula patients from Jos in north central Nigeria, Wall and colleagues (Wall, Karshima et al. 2004) found that only 26.4% of these women were still married: 22.1% were separated from and 48.9% had been divorced by their husbands.

Infertility is a devastating problem to couples in any culture, but it is difficult to underestimate the importance of fertility in African societies. Large families are a source of pride and a symbol of affluence. Since the social, economic, and political lives of these societies are still dominated in many respects by ties of kinship, not having offspring is a disaster on many fronts. Furthermore, large families may be the only source of reliable (or affordable) farm labor, a critical economic factor in societies based on pea-

sant agriculture. Because governmental social welfare programs are unreliable or non-existent in most African countries, children are the only hope one has for security in old age. The fetal mortality in individual cases of obstructed labor is staggering, with fetal loss typically running in excess of 90%. The overall reproductive histories of women with an obstetric fistula is similarly dismal: In the large series of 899 fistula patients from Jos, Nigeria, Wall and colleagues (Wall, Karshima et al. 2004) found that out of a total of 2,729 infants born to these fistula patients, only 819 living children survived, a long-term survival rate of only 30%. Since obstructed labor is most commonly a complication of a woman's first labor, and since she is typically infertile thereafter, the majority of fistula victims (about 70%) have no living children. Not only is this a disaster for the affected woman, but from her husband's perspective, it puts his whole future in jeopardy as well. Faced with this prospect, many men find it easier to rid themselves of their damaged wives and seek other, fertile, spouses.

Although obstructed labor is most common as a complication of a first pregnancy, it can occur in any pregnancy if the baby is too large, if labor starts with a fetal malposition or malpresentation, or if other complications arise. Not all obstetric fistulas occur in teenaged girls having their first baby: in a review of 121 obstetric fistulas from Kumasi, Ghana, Danso and colleagues found that 43% of their patients had had three or more pregnancies, and that 25% had had five or more (Danso, Martey et al. 1996). Wall and co-workers (Wall, Karshima et al. 2004) found that 45.8% of fistulas occurred in first pregnancies, but that 20% of fistulas occurred in women of high parity ($\geq$ 4 pregnancies). Similarly, at the Addis Ababa Fistula Hospital, nearly 25% of fistula patients have had three or more pregnancies, and 11 percent have had six or more children (Kelly and Kwast 1993). What happens to the living children when their mother's life is ruined in this fashion? Important indirect health consequences of fistula formation such as this have been largely unexplored.

b) Religious and Social Implications

In some parts of the world, such as northern Nigeria, married women live under a system of "wife seclusion" in which their social contacts are severely restricted to her immediate family and female neighbors (Wall 1988; Wall 1998). The offensive odor that accompanies total urinary and/or fecal incontinence usually curtails even this limited opportunity for social interaction. In order to deal with the never-ending problem of foul smells and omnipresent urine and fecal loss, the families of these patients often remove them from the main family dwelling into a peripheral hut, sometimes even forcing them to live out doors. Not uncommonly, they are often forced out of the family compound altogether over time (Hamlin and Little 2001; Wall 2002).

Because of the nature of her injury, a fistula patient simply cannot maintain normal hygiene, no matter how hard she tries. This fact has an enormous impact on all aspects of her life, including her participation in religious or spiritual life. Fistula women are generally regarded as both physically and ritually unclean. Many African religious groups, especially Muslims, require personal cleanliness as a prerequisite for worship. This often excludes them from participation in religious activities (often a central concern of African social life), this further diminishes their sense of self-worth and social connectedness.

The tragedy faced by these women was described very eloquently by Kelsey Harrison, who had extensive experience with their plight as a result of his long tenure as Professor of Obstetrics and Gynaecology at Ahmadu Bello University in Zaria, Nigeria (Harrison 1983):

> "Whether in hospital or outside, their own society goes to great lengths to ostracize these girls, an action disparaged by outsiders but considered reasonable by most local people including certain (male) health workers. Their point of view is straightforward enough. The safe delivery of a healthy baby is always an occasion for great rejoicing and at the naming ceremony held on the eighth day after birth, the whole family and local community celebrate. In the case of the girl with an obstetric fistula, the baby is usually stillborn and this together with the fact that her odour is offensive means that such celebrations cannot take place. Soon, her incontinence becomes confused with venereal disease, and the affected family feels a deep sense of shame. The consequences are devastating: the girl is initially kept hidden; subsequently, she finds it difficult to maintain decent standards of hygiene because water for washing is generally scarce; divorce becomes inevitable and destitution follows, the girl being forced to beg for her livelihood. So traumatic is this experience that even when cured, some girls never regain their self esteem."

In considering the overall impact of the fistula problem, one should consider the life-time burden of suffering that this condition presents. The vast majority of these women are young and develop their fistula in their first pregnancy. In a series of over 9,000 fistula victims in Ethiopia the average patient age was 19 yrs (Arrowsmith, Hamlin et al. 1996). Most of the injuries associated with prolonged obstructed labor cause permanent disability without causing early death. The members of the committee have seen patients seeking surgery over 40 years after their initial injury: the wasted years of human life represented by such cases is mind-numbing.

Professor Abbo Hassan Abbo, Professor of Obstetrics and Gynaecology at the University of Khartoum in the Sudan, himself an international authority on fistulas, tells a powerfully poignant story of a group of Somali women with fistulas who, in despair, chained themselves together and jumped off the dock in Mogadishu in a mass suicide because their suffering had become unendurable. (A.H. Abbo, personal communication).

It is easy to overlook the enormous social consequences that a fistula produces for the afflicted woman unless one sees her in her own social setting. The proper care of fistula victims requires a holistic approach that pays as much attention to healing the psycho-social wounds inflicted on these women as it does to curing their physical injuries (Wall 2002). Programs for women with obstetric fistulas must encompass education, literacy training, the development of social networks, and the provision of skills with which to earn an adequate livelihood, if the social problems that these women face are to be overcome (Bangser, Gumodoka et al. 1999). Some women are so injured that they can never return to their home villages, and many have such serious medical problems that they linger around fistula centers and become permanent residents. At the Addis Ababa Fistula Hospital, many of these women become nursing aides, taking care of other fistula patients. In a unique social experiment, that institution is developing a permanent residential farm for the most severely injured of these women, in essence forming a new women's community based on shared experiences and the "sisterhood of suffering" that has resulted (Hamlin and Little 2001).

V. THE CLASSIFICATION OF OBSTETRIC FISTULAS

At the present time, there is no generally accepted, standardized system for describing, classifying, or staging obstetric fistulas. The situation remains much the same as it was in 1951, when Bayard Carter and colleagues lamented (Carter, Palumbo et al. 1952), "It is difficult to interpret and to compare many of the reported series of fistulas. There is a real need for standard methods to describe the fistulas, the actual operations, and results." McConnachie (McConnachie 1958) eloquently summed up the problems surrounding discussions of fistula repair in the following words:

> "It is common to find that each author has either used his own form of classification based solely on the anatomical structures involved, or the size of the fistula, or even one of convenience. But no two writers seem to have reached any common grounds for agreement other than that a urinary fistula is present. This lack of agreement has prevented comparison between individual workers' material or results, based on a common scientific classification. Such classification needs to be full yet simple, workable in its details so that it will not be cumbersome, to be based on the three principal anatomical structures involved in urinary leakage [bladder, urethra, ureters], and to take into account the clinical aspects of site, size, accessibility and condition of the tissues involved in attempted repair."

In describing their experience with fistula repair, many surgeons have put forth various systems or rationales for grouping cases together. The earliest such system was that of Sims (1852) who classified fistulas according to their location in the vagina: 1) urethro-vaginal fistulas, where the defect was confined to the urethra; 2) fistulas situated "at the bladder neck or root of the urethra, destroying the trigone;" 3) fistulas involving the body and floor of the bladder; and 4) utero-vesical fistulas where the opening of the fistula communicated with the uterine cavity or cervical canal. Succeeding authors have added to, modified, and re-grouped the categories of fistulas in a variety of ways (Emmet 1868; Mahfouz 1930; Thomas 1945; Krishnan 1949; McConnachie 1958; Moir 1967; Lawson 1968; Hamlin and Nicholson 1969; Waaldijk 1994; Waaldijk 1995; Hilton and

Ward 1998). Mahfouz (Mahfouz 1930) listed the main points to be considered in the evaluation of a fistula as follows:

- The situation, size, form and variety of the fistula
- The scarring of the vagina and its effect on the mobility of the fistula
- The attachment of the fistula to the pelvic walls
- The condition of the urethral sphincter and permeability of the internal orifice of the urethra (occasionally the urethra is completely occluded by fibrosis)
- The location of the ureteral orifices, and their relation to the edges of the fistula
- The presence of complications such as recto-vaginal fistula, inflammatory lesions of the pelvis, vagina, vulva or peritoneum
- The presence of more than one fistula

There is an urgent need to develop a standardized, generally-accepted system for describing and classifying fistulas, to aid communication between fistula centers and to facilitate research in this field. The committee has not taken upon itself the task of developing such as system, but recommends that the Standardization Committee of the International Continence Society make this a priority in the future. The committee feels that the following factors should be taken into account in the development of a standardized ICS Classification System:

- The system should provide a simple yet precise method of describing fistula location and size. Although the size of the fistula may be quite impressive in cases of prolonged obstructed labor, the actual size of the opening is probably less important in the overall prognosis than are other factors. As John St. George noted in 1969 (St. George 1969), "This [size] is not very important as long as other factors are favourable. It has been found that an opening of 1 cm or less with unhealthy tissues, fixed to bone within a stenosed vagina, is worse than an opening of 5 cm or more with lax vaginal walls, no fixity and a wide vaginal introitus. Also, a small bladder neck fistula is found to be more difficult and less successful at repair than a large mid-vaginal fistula."
- The system should make some attempt to assess the impact of the fistula on function; i.e. how does the fistula impact the bladder neck, urethra, ureters, or (in the case of rectovaginal fistulas) the anus and its sphincter mechanism?
- The presence, location, and degree of vaginal scarring should be quantified, as this appears to be directly related to the probability of successful fistula closure. Many authors have commented on the grim prognosis for fistulas complicated by vaginal scarring. Das and Sengupta noted (Das and Sengupta 1969): "Massive scarring is frequently present and is definitely a great handicap for a successful vaginal operation. Annular constriction ring around the vagina, distal to the fistula, with fixity to the pubic bones with cartilagenous margins are very unfavourable signs. But, fortunately it is noted that once the neighbouring bands of adhesions are released, the bladder can be brought down easily and anatomic apposition made."
- Any classification system for fistulas should be based on criteria that correlate with the prognosis for successful surgical repair. This will require looking at the whole patient, rather than simply looking at just the fistula. In a comparative study of failed fistula repairs carried out in Addis Ababa, Kelly and Kwast (Kelly and Kwast 1993) found a statistically significant association ($p < 0.001$) with failed fistula repair and a ruptured uterus, with a previous history of failed surgical repair (especially repairs carried out at other, non-specialist, institutions), with the presence of limb contractures, with the need for special preoperative feeding in order to become fit enough for surgery, and with the presence of a "complicated" fistula requiring more extensive, more complicated, surgical intervention. These authors believed that these factors reflected a more extensive injury from prolonged obstructed labor. McConnachie (McConnachie 1958) suggested that failures in fistula surgery were due to previous failed repairs with increased scar tissue formation, differences in the grade and type of fistulas reported in various series, to inexperienced operators taking on cases beyond their surgical capabilities, and "residual urinary sepsis and alkalinity." Further comparative studies are needed to ascertain if these factors are reliably associated with surgical failure, and to determine if other, as yet unascertained, factors are also related to a poorer surgical prognosis.
- There should be a standardized definition of "success" in fistula surgery. In his series of 303 fistulas, McConnachie (McConnachie 1958) refused to regard the patient as "cured" even though the fistula was "closed" unless "she also has complete urinary continence and control." This principle

reduced his overall success ("closed and dry") rate from 79.5% to 65.1%. Perhaps as many as one third of women who undergo successful fistula *closure* still have significant incontinence due to the presence of sphincteric damage and/or other persistent alterations in bladder or anorectal function. To classify as a "success" a woman who has a closed fistula but continuous, debilitating stress incontinence from a non-functioning urethra is both dishonest and clinically unhelpful.

- In describing surgical success rates, the time at which this assessment is made must be clearly specified. Long-term outcome data on women who have undergone fistula repair surgery are almost entirely lacking in the literature. Given the difficult circumstances from which most fistula patients come, and the difficulties of travel and communication in rural Africa, this is not surprising. As a result of these problems, most "successes" are reported as such only at the time of discharge from hospital, with almost no further follow-up. This may well be misleading as to actual outcome. Coetzee and Lithgow (Coetzee and Lithgow 1966) defined "cure" of a patient with a vesicovaginal fistula as follows:
- "For a 100% cure the following conditions must be fully satisfied: 1) The patient should have complete continence by day and by night, and to achieve this it has been found that the bladder should hold a minimum of 170 ml. 2) No stress incontinence should be present. 3) The vagina should allow normal coitus without dyspareunia. 4) Traumatic amenorrhea should not result. 5) The patient should be able to bear children."

Achieving standards this high in patients who have undergone extensive pelvic trauma from obstructed labor will not be easy, but honesty is the first prerequisite if progress is to be made with true scientific integrity.

- General agreement should be reached concerning what constitutes an "irreparable fistula"—that is, which women should be offered urinary and/or colonic diversion as their first surgical procedure, rather than undergo an attempt at fistula closure? The committee recommends that the term "irreparable fistula" be used in preference to the phrase "hopeless fistula," which is sometimes encountered in these discussions.
- Any system for the classification or staging of obstetric fistulas must emphasize low-technology clinical assessment, since such a system will have to be used in areas of the world with extremely limited resources. Fistulas afflict the world's poorest women, not the affluent elites of industrialized economies.
- In view of the multi-system pathology produced by obstructed labor, any classification system should note the presence of associated conditions related to the primary pathophysiological process in obstructed labor, such as the presence of neurologic injury, damage to the pubic symphysis, the concurrent presence of a recto-vaginal fistula, the presence of chronic skin ulcers, nutritional state, etc.
- Because most of the suffering endured by fistula victims is the result of social isolation and abandonment and the subsequent loss of self-esteem and economic deprivation that results from this social isolation, the evaluation of women with obstetric fistulas should include information on these social "co-morbidities." The fistula problem in the developing world is inextricably intertwined with its social milieu, and this must be openly acknowledged.

VI. EARLY CARE OF THE FISTULA PATIENT

Although many patients with vesico-vaginal fistulas appear for care many years after they have sustained their injury, others arrive at a medical facility in obstructed labor, or shortly after the fistula appears. The traditional teaching has been that an attempt at repair should be deferred for three months until the extent of the injury has fully manifested itself and any infection/inflammation in the injured tissues has resolved. However, it also appears to be true that some fistulas might be prevented by prompt treatment of women who arrive at a health-care facility immediately after obstructed labor, that some fistulas might close spontaneously if the bladder is drained for a prolonged period of time, and that a subset of fistulas might even be amenable to early closure. John St. George (St. George 1969) believed that prompt medical treatment of patients after obstructed labor could prevent post-partum sepsis and promote the healing of injured tissues, thus preventing some fistulas altogether, or at least minimize the extent of injury that developed. He advocated vigorous local care of the injured tissues and prompt antibiotic treatment as soon as such patients were seen. He described one particularly noteworthy case:

"The patient, who was aged 18, was brought to the hospital three days after delivery, following labour which lasted seven days. She was incontinent of urine and faeces. She was very pale (haemoglobin concentration 3.7 g per 100 ml), dehydrated, toxic and unable to walk. Vaginal examination revealed a gaping opening with offensive purulent lochia and discharge. The lateral walls of the vagina had sloughed, revealing both pubic rami and the right ischial tuberosity. The perineum was torn, leaving an indefinite anal sphincter. A large vesico-vaginal fistula and a small recto-vaginal fistula, both with infected edges, were seen. Apart from blood transfusions, parenteral antibiotics and high protein diet were given: the vagina was douched twice daily with warm Dettol solution; this was followed each time by insertion of layers of sofra tulle gauze. After three weeks, the local treatment was given only once daily for another three weeks. When the patient was examined under anesthesia ten weeks after admission, and before discharge from hospital, the vaginal walls had healed over and returned to normal; the perineum had healed, leaving only a wide vaginal introitus; the recto-vaginal fistula had healed and the vesico-vaginal fistula was reduced to 1 cm diameter with mobile surrounding edges. She returned for repair three months later, and this was successfully carried out. Prevention of sepsis was the chief factor in such a transformation as occurred in this case, as in many others, and repair would otherwise have failed."

Further research on the effectiveness of immediate local care after fistula formation should be encouraged. Waaldijk (Waaldijk 1994) found that 50 - 60% of smaller fistulas ($\leq$ 2 cm) would heal spontaneously, if prompt prolonged bladder drainage was started within three months of the initial injury. If the fistula did not close with simple catheter management, he performed an early surgical closure. Using this regimen, he reported a successful closure rate in 92% of cases, with continence in 94% of those in whom the fistula was closed successfully. These results are encouraging, but await replication at other centers.

VII. SURGICAL TECHNIQUE FOR FISTULA CLOSURE

In general, specific issues of surgical technique are among the least important issues in obstetric fistula repair today. In practiced hands, skilled fistula surgeons routinely achieve fistula closure rates of 80% or better. Multiple papers reporting large case series support this contention (Mahfouz 1929; Mahfouz 1930; Mahfouz 1934; Mahfouz 1938; Krishnan 1949; Abbott 1950; Lavery 1955; Mahfouz 1957; Naidu 1962; Aziz 1965; Yenen and Babuna 1965; Coetzee and Lithgow 1966; Hamlin and Nicholson 1966; Moir 1966; Bird 1967; Moir 1967; Hamlin and Nicholson 1969; Mustafa and Rushwan 1971; Lawson 1972; Ashworth 1973; Waaldijk 1989; Iloabachie 1992; Kelly 1992; Arrowsmith 1994; Amr 1998; Goh 1998; Hilton and Ward 1998; Gharoro and Abedi 1999; Wall, Karshima et al. 2004). There is a fairly general consensus concerning the basic principles of fistula repair, which can be summarized as follows:

- The best chance for successful fistula closure is at the first operation. In their large series of 2,484 fistula patients, Hilton and Ward (Hilton and Ward 1998) reported successful fistula closure in 82.8% of patients at the first attempt. Successful closure was achieved in only 65% of those patients who required two or more operations.
- The fistula should be widely mobilized from the surrounding tissues at the time of repair, so that fistula closure can be achieved without tension on the site of repair.
- The repair must be "water-tight" at the time of closure. If it is not, failure is virtually certain. The simplest way to test this is to instill a solution of colored water into the bladder at the time of fistula closure and make certain that no leakage can be demonstrated. If leakage occurs, the operation must be revised until leakage can no longer be demonstrated. As J. Marion Sims wrote in his original paper on fistula repair (Sims 1852), "if a single drop of urine finds its way through the fistulous orifice, it is sure to be followed by more, and thus a failure to some extent is almost inevitable."
- The traditional teaching has been that the fistula should be closed in multiple layers, avoiding overlapping suture lines, whenever this can be achieved; however, in some cases there is simply not enough tissue present to achieve a multi-layered closure, and recently some surgeons have begun experimenting with single-layer closure techniques. At present, no data are available to assess the effectiveness of single-layer closure techniques in an objective fashion.

- After fistula repair, the bladder should be emptied by prolonged continuous catheter drainage in order to prevent distention of the bladder and increased tension on the suture lines. The traditional duration of bladder drainage is 14 days, but no comparative trials have been carried out to see if shorter duration of bladder drainage (for example, 7 or 10 days) is associated with increased risk of failed repair. Research on the optimal duration of bladder drainage is important, and has obvious consequences for fistula centers with large clinical volumes. If, for example, the duration of post-operative catheterization could be decreased from 14 days to 10 days without a significant increase in failure rates, the center could increase the number of fistula patients undergoing surgical repair by almost 30%.
- Especially in the case of fistulas due to prolonged obstructed labor where the injury is the result of prolonged ischemia and tissue necrosis, successful closure is enhanced by the use of tissue grafts (bulbocavernosus graft, gracilis muscle graft, etc.) which bring a new blood supply to the site of repair. There is one retrospective paper in the literature that evaluated the repair of comparable fistulas with and without the use of Martius bulbocavernosus flaps and demonstrated substantially higher rates of successful closure when such a graft was employed (Rangnekar, Imdad et al. 2000).

Each fistula is unique, and an ability to improvise in the face of unexpected findings or complications is a virtue that every fistula surgeon must strive to develop. It is clearly not possible to illustrate here every different type of fistula and all of the various techniques that may be employed to close them. However, a generally accepted technique—-based largely on the work of Drs. Reginald and Catherine Hamlin at the Addis Ababa Fistula Hospital in Ethiopia where nearly 25,000 obstetric fistulas have now been repaired— can be described and illustrated as follows (Figures 10 - 29). The first prerequisite for successful fistula repair is meticulous attention to detail. As Abbot aptly (if somewhat quaintly) noted (Abbott 1950), "There must be no attempt to operate on these cases with one eye on the clock and the other on the tea wagon. In fact, the operator upon vesico-vaginal fistulae should combine the traits of daintiness, gentleness, neatness and dexterity of the pekinese, with the tenacity and perseverance of the English bulldog."

The position for fistula surgery depends upon the nature and location of the fistula to be repaired. For the vast majority of straightforward fistulas (especially for mid-vaginal fistulas) a high lithotomy position with the buttocks pulled well over the edge of the operating table, provides excellent exposure (**Figure 10**). Surgery in this position is easy to perform under spinal anesthesia, which is the cheapest and easiest form of anesthesia for "low technology" settings in developing countries. To operate in the knee-chest position is relatively uncomfortable for patients and can compromise pulmonary function. Performing operations in the knee-chest position generally requires intubation of the patient, the use of general anesthesia, and continuous ventilation. Trans-abdominal surgery with the patient in the supine position is rarely needed, except for certain complex fistulas. An abdominal approach increases both the cost of surgery and the likelihood of complications, such as wound infections. When doing fistula surgery in the developing world, failure to use a trans-vaginal approach requires special justification, such as cases in which additional intra-abdominal pathology must be addressed.

The first requirement for successful fistula repair is adequate exposure of the operative field. **Figure 11** depicts a typically narrow, scarred vagina of the type that often develops after obstructed labor. The vesicovaginal fistula is obscured by scar tissue and a constriction ring, and is not clearly visible. When this scar tissue is released by performing vaginal relaxing incisions, the fistula can be seen and repaired. The fistula depicted here is a straightforward mid-vaginal vesico-vaginal fistula.

It is generally preferable to identify and catheterize the ureters in most operations so that they are readily identifiable throughout the course of the operation. This can usually be done by passing catheters through the fistula into the ureters under direct vision (**Figure 12**). The purpose of ureteral catheterization is to ensure that the ureters are not inadvertently ligated during the fistula repair, with subsequent renal damage or death. (This was the cause of death in Sims' only operative fatality; unfortunately, it occurred in a very public demonstration of his technique for fistula closure in London at the Samaritan Hospital; see page 518 (McKay 1922). Once the ureters have been catheterized, the ureteral catheters can be brought out of the bladder through the urethra, keeping them away from the operative field. Although some fistula surgeons prefer to leave ureteral catheters in place for up to 14 days after surgery, current Western urological practice would suggest that such

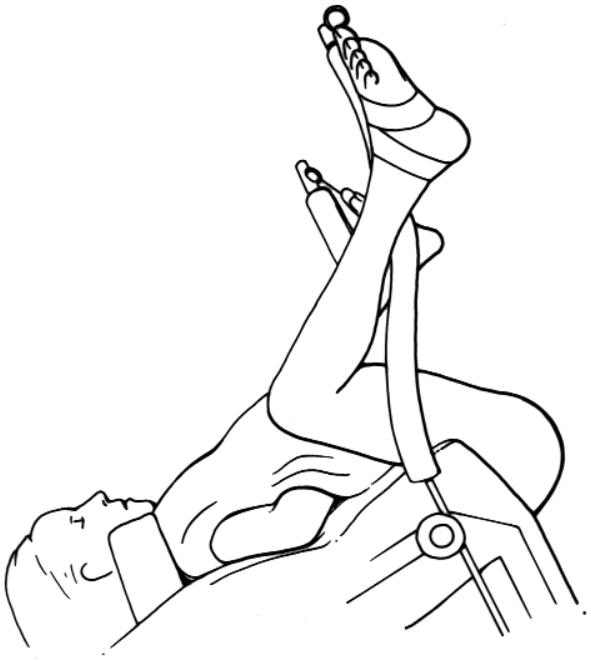

Figure 10. Exaggerated lithotomy position for fistula repair. The patient is positioned at 35 - 45 degrees, head down position, with the use of shoulder supports and the buttocks pulled over the edge of the table. (©Worldwide Fistula Fund, used by permission).

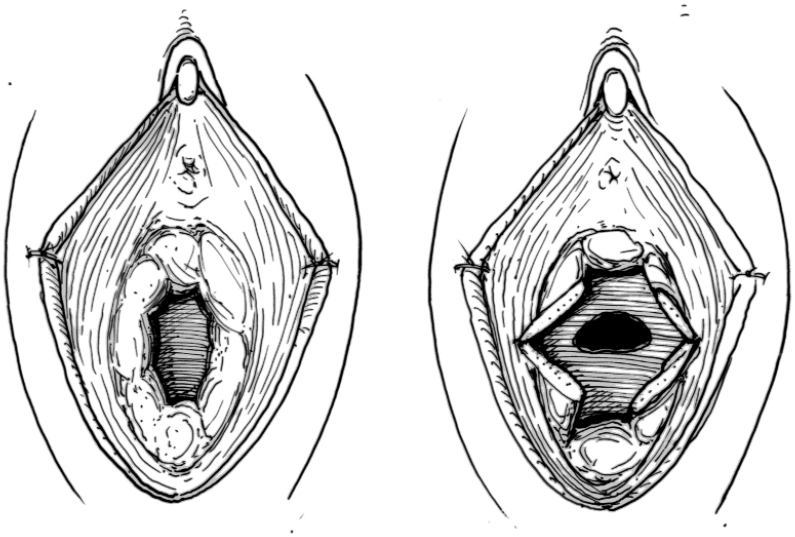

Figure 11. Placement of labial stay sutures helps increase lateral exposure. Incisions through bands of scar tissue are often necessary to allow insertion of retractors. Left side of the illustration shows the vagina prior to relaxing incisions. Right side shows enhanced exposure after relaxing incisions. (©Worldwide Fistula Fund, used by permission).

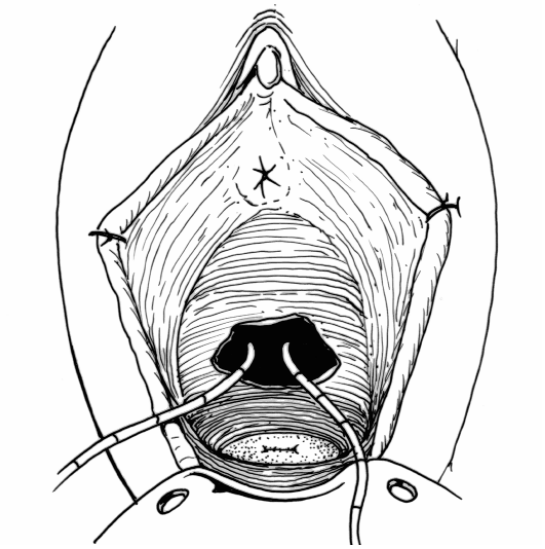

Figure 12. Ureters are identified and cannulated, if possible. The use of intravenous diuretics and/or vital dyes can be used to improve ureteric localization, if needed. (©Worldwide Fistula Fund, used by permission).

catheters can be removed immediately at the end of the case, or within a day or two after surgery at most.

Once the fistula is exposed and the ureters are identified, it is important to mobilize the fistula fully so that it may be closed without tension. **Figure 13** demonstrates the first move in mobilizing a mid-vaginal fistula. The posterior border of the fistula is incised and the incision is carried out laterally onto the vaginal sidewalls. The incision extends only through the vaginal epithelium, not into the bladder itself. Wide vaginal dissection will allow complete mobilization of the fistula.

Following the initial vaginal incision, the posterior vaginal flap is developed, always keeping the course of the ureters in mind (**Figure 14**).

Continued mobilization of the fistula is achieved by extending the incision circumferentially around the fistula, then anteriorly towards the urethra (**Figure 15**). As before, the incision extends only through the vaginal epithelium, not into the bladder. When this portion of the operation has been completed, the bladder should be freed completely from the vagina.

The anterior vaginal flaps then are developed widely to mobilize the fistula more completely (**Figure 16**). Due to the presence of scarring and tethering of the fistula, it is generally useful to carry the anterior dissection upwards behind the pubic symphysis, opening the retropubic Space of Retzius and detaching the bladder from its supports in this area. This allows full mobilization of the fistula (**Figure 17**). The anterior vaginal flaps can be sutured out of the operative field using "stay sutures."

Additional tension may be taken off the fistula at this point by performing a partial bladder suspension by passing sutures from the bladder up behind the pubic symphysis and anchoring the sutures in the symphyseal periosteum (**Figure 18**). Persistent stress incontinence is relatively common in patients after otherwise successful fistula closure. It has been argued that suture placement of this type reduces the prevalence of this problem post-operatively (Hassim and Lucas 1974; Hudson, Henrickse et al. 1975); however, no controlled studies have yet been carried out that document this assertion.

Once the fistula has been mobilized as fully as possible, fistula closure can begin. There are many different techniques by which this task may be accomplished. One proven technique is to close the first layer of the bladder with a continuous, running, interlocking stitch of an absorbable suture (**Figure 19**). The initial suture bite should be placed beyond the lateral margin of the fistula and the last suture should be placed in a similar position on the opposite side of the fistula. Although Sims initially "pared back" the edges of the fistula in his closure technique, there seems to be no need to do this in the vast majority of obstetric fistulas: a better philosophy is to preserve as much bladder tissue as possible, particularly when attempting to close extensive fistulas.

After initial fistula closure has been completed, the primary suture line should be reinforced by a second layer of closure if at all possible. Ideally this should be done in such a fashion that the second row of sutures imbricates the initial closure, rolling more bladder tissue over the first line of closure in order to protect it (**Figure 20**). When the second layer has been closed, the integrity of the repair should be checked by instilling 150 - 250 ml of water colored with indigo carmine, methylene blue, or another suitable dye. If there is no leakage of colored water, the fistula repair can be assumed to be "water tight," and the operation can proceed. If leakage is observed, the repair should be revised until no more leakage is observed.

Extensive experience with fistula repairs has led many surgeons to believe that successful fistula closure is markedly enhanced by the use of a bulbocavernosus fat pad (Martius) graft (Shaw 1949; Martius 1956; Hamlin and Nicholson 1966; Hamlin and Nicholson 1969; Baines, Orford et al. 1976; Zacharin 1980; Given and Acosta 1989; Elkins, Delancey et al. 1990; Fitzpatrick and Elkins 1993; Punekar, Buch et al. 1999; Rangnekar, Imdad et al. 2000). There is one small comparative surgical study that documents this finding (Rangnekar, Imdad et al. 2000).

Development of the fat pad graft should begin with a vertical midline skin incision on the left or right labium majus, extending from the base of the mons pubis to about the level of the middle of the vaginal introitus (**Figure 21**). Sharp dissection with a surgical scissors is used to expose a central "cord" of labial fat, and this dissection is carried down to the deep fascial layer **(Figure 22**). Even in thin, malnourished women, dissection of this fat is always possible. Once this "cord" of fat has been identified and dissected, it is cross-clamped superiorly with a single clamp and transected (**Figure 23**). The superior stump is suture-ligated to achieve hemostasis.

Next, the superior aspect of the graft is grasped gently with an Allis forcep and the cord of fat is further

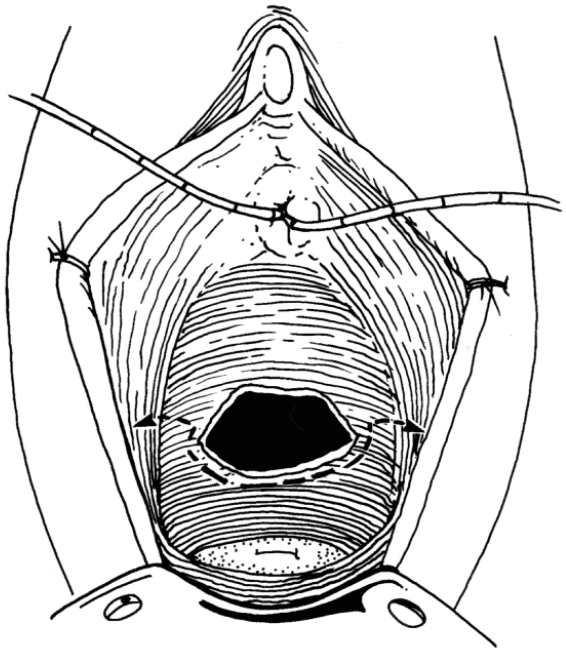

Figure 13. Once the ureters have been catheterized through the fistula, the catheters may be brought out through the urethra to move them out of the operative field. Dissection of the fistula begins at its posterior margin by making an incision that runs from one vaginal sidewall to the other. Accentuation of tissue planes in some cases may be aided by local infiltration of saline or local anesthetic. (©Worldwide Fistula Fund, used by permission).

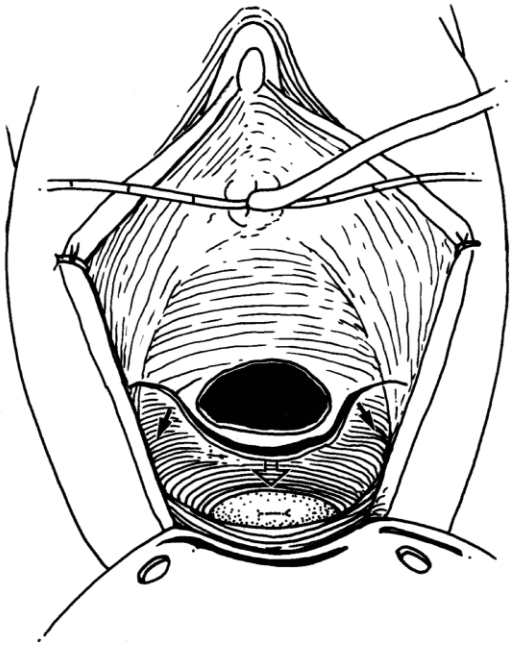

Figure 14. Complete mobilization of the fistula is continued by raising posterior vaginal flaps. The mobilization is carried out to each vaginal sidewall as well as to the cervix (if one is still present). Special care must be taken at the 4 and 7 o'clock positions to avoid possible injury to the ureters. (©Worldwide Fistula Fund, used by permission).

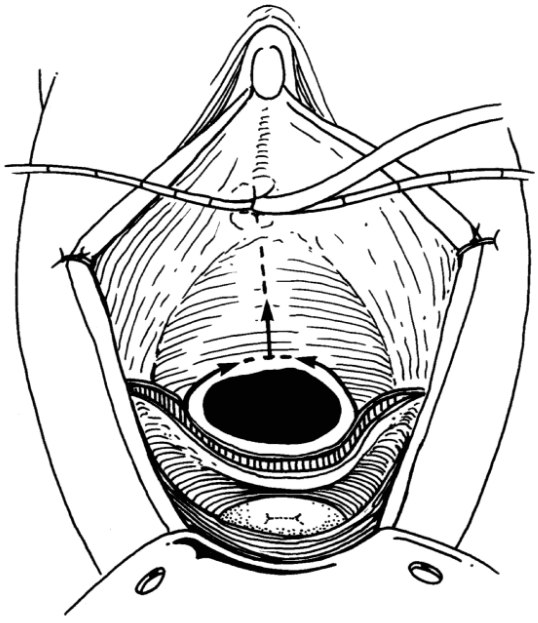

Figure 15. The mobilizing incision is extended circumferentially around the fistula. When this is completed, an anterior midline incision is made in the vagina and extended up towards the external urethral meatus. (©Worldwide Fistula Fund, used by permission).

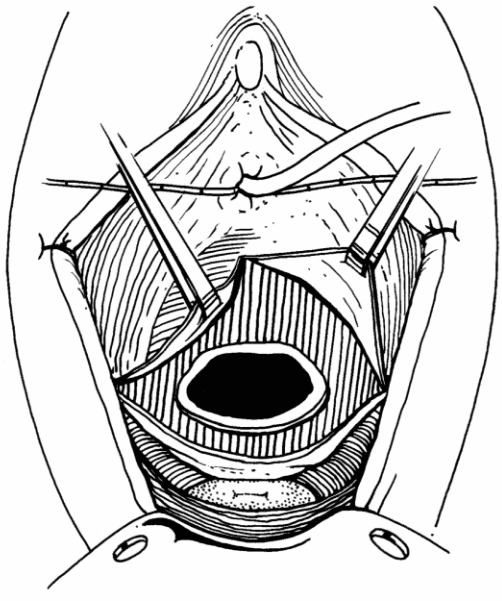

Figure 16. The anterior vaginal flaps should be mobilized all the way from the edge of the fistula to the pubic arch. (©Worldwide Fistula Fund, used by permission).

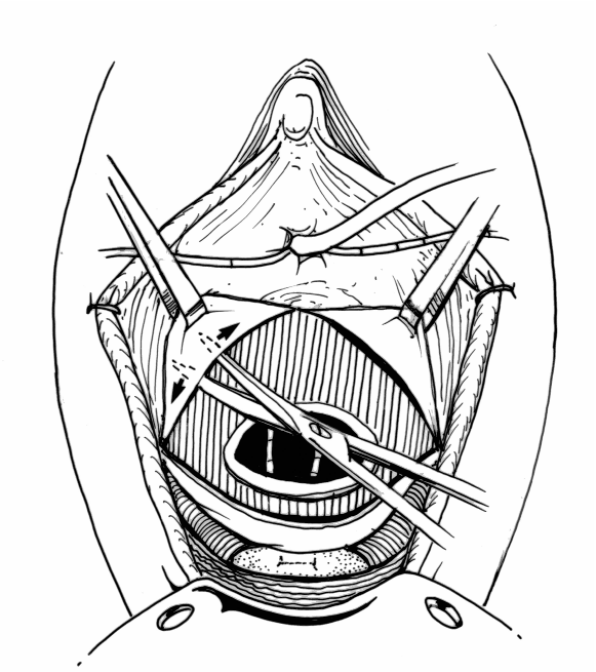

Figure 17. Once the anterior flaps have been fully developed, the endopelvic fascia is perforated and the space of Retzius is entered, to complete the full mobilization of the fistula. This portion of the operation is often technically challenging. The apices of the anterior vaginal flaps can be retracted out of the operative field with stay sutures to improve visualization of the fistula. At this point, the bladder base and vagina should be completely separated from one another. It is generally not necessary (or advisable) to trim or "pare back" the edges of the fistula. This only increases the size of the defect and decreases the amount of remaining bladder tissue. (©Worldwide Fistula Fund, used by permission).

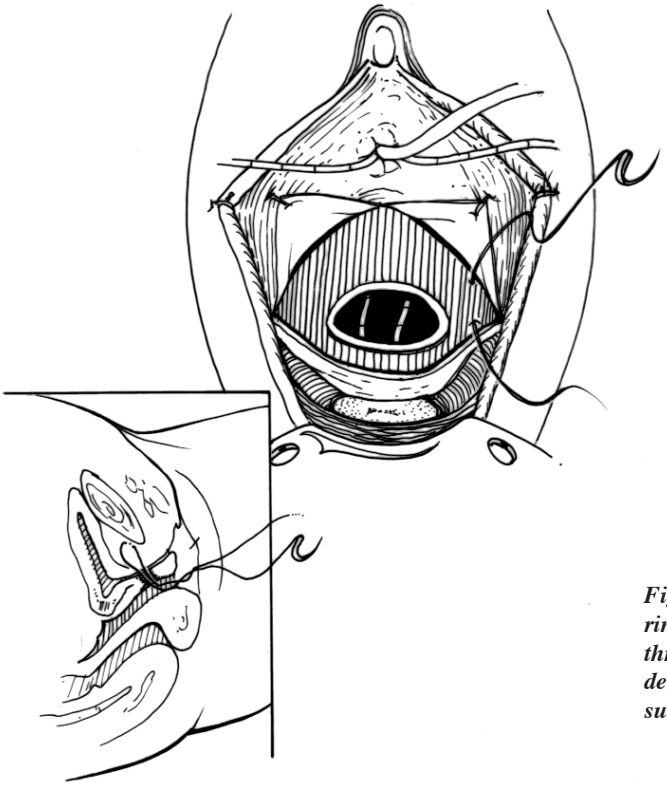

Figure 18. Closure of the fistula begins by placing anchoring sutures lateral to the bladder defect and superiorly through the periosteum of the pubic arch. The sutures are designed to decreases tension across the line of bladder closure. (©Worldwide Fistula Fund, used by permission).

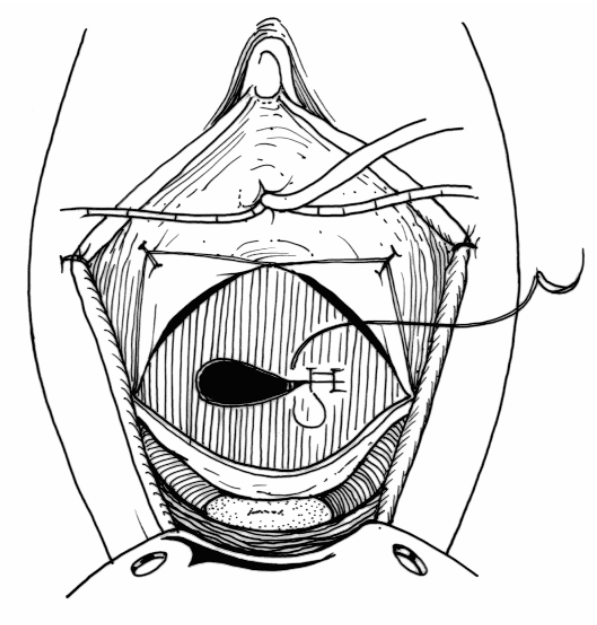

Figure 19. Fistula closure. The bladder defect is closed in two layers using absorbable suture. If any tension is encountered during bladder closure, the initial dissection has been inadequate and should be revised. The first closure can be made with either interrupted sutures or a continuous running, interlocking, suture. (©Worldwide Fistula Fund, used by permission).

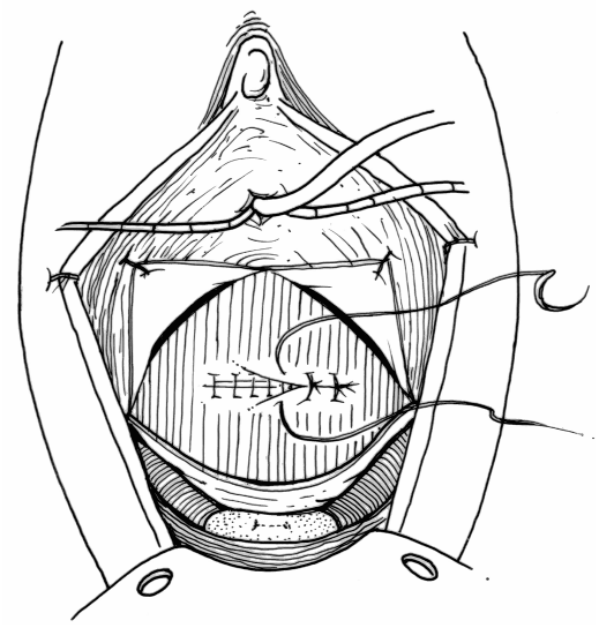

Figure 20. Fistula closure. A second set of sutures is placed, imbricating the second suture line over the first. When this has been completed, "water tight" closure of the fistula should be confirmed by gentling filling the bladder with a solution of colored water or sterile infant feeding formula to check of leakage. If any leakage is noted, the repair should be taken down and reclosed until no leakage can be demonstrated. (©Worldwide Fistula Fund, used by permission).

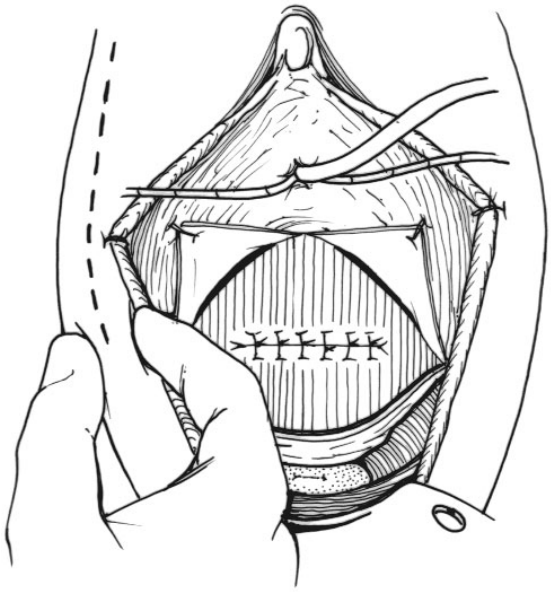

Figure 21. Martius bulbocavernosus fat flap. A vertical skin incision is made in the labium majus from the base of the mons to the level of the middle of the vaginal introitus. (©Worldwide Fistula Fund, used by permission).

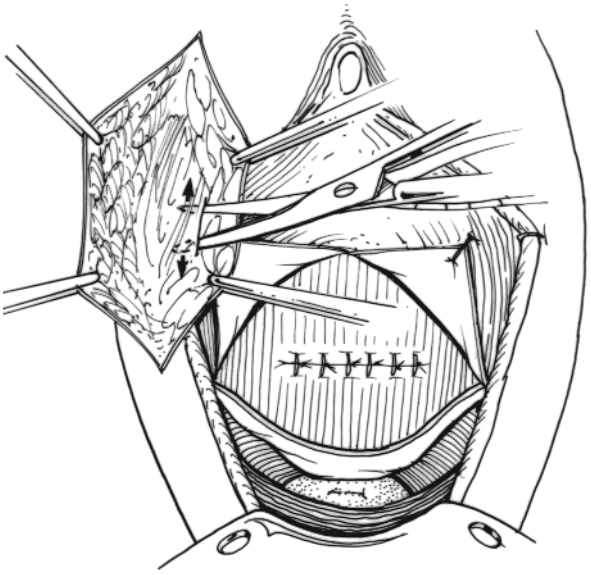

Figure 22. Martius flap. Lateral and medial dissection of the bulbocavernosus fat is made down to the deep fascial layer, exposing a "cord" of labial fat. (©Worldwide Fistula Fund, used by permission).

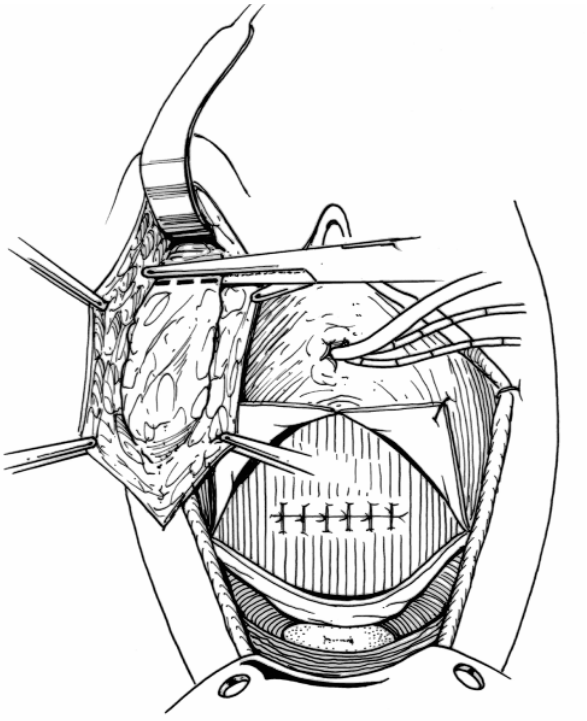

Figure 23. Martius flap. Once the "cord" of fat has been identified and dissected, it is cross-clamped superiorly and divided. The superior stump is suture-ligated to insure hemostasis. (©Worldwide Fistula Fund, used by permission).

mobilized down to its base. It is important to protect the base of the pedicle to insure that its blood supply remains intact (**Figure 24**). At this point, surgical scissors are used to dissect a tunnel that extends from the base of the fat pad's pedicle into the vagina, traveling between the vaginal epithelium and the pubic arch (**Figure 25**). The tunnel should be large enough to allow passage of the surgeon's finger from the labial defect down to the bladder base (**Figure 26**).

Prior to passing the graft through the tunnel, four anchoring stitches of absorbable suture should be placed into the muscularis of the bladder at the 2,4, 8, and 10 o'clock positions. This allows the Martius graft to be anchored into place securely against the repaired fistula, protecting it and bringing in a new blood supply to nourish the surgical site (**Figure 27**). The graft is then passed through the tunnel to the bladder base and is anchored into position using the previously placed anchoring stitches. The fistula site should be completely covered at this point (**Figure 28**).

Finally, the stay sutures which had been holding the anterior vaginal flaps out of the surgical field are released and the vaginal defect is closed as an "inverted T" (**Figure 29**). The ureteric catheters can now be removed and a vaginal pack placed, if desired.

VIII. COMPLICATED CASES AND TECHNICAL SURGICAL QUESTIONS

1. The fistula complicated by urethral damage

Virtually all authors with extensive experience in the management of obstetric fistulas comment on the great difficulty in achieving post-operative continence in patients who have had extensive damage to the urethra, even if the fistula defect itself can be closed successfully. J. Chassar Moir, the great British gynecologist, (Moir 1965) referred to the worst of these cases as "circumferential" fistulas, which "involve a destruction of the bladder neck not only on the vaginal side but, in many instances, on the pubic side as well. The result is a circumferential sloughing with subsequent discontinuity of the urethra and bladder; the intervening tissue is merely the epithelium that has grown over, and become adherent to, the periosteum of the back of the pubic bone." Fistulas involving this level of destruction are daunting, and are rarely seen in developed countries. According to Moir, the three great problems involved in dealing with this type of fistula are: 1) extremely difficult exposure; 2) technical difficulty in dissecting the tissue remnants from the pubic bone; and 3) difficulty in joining the bladder neck to the urethral remnant or stump, if, indeed, any portion of the urethra is still intact. The basic principles of technique needed to deal with this type of injury are complete mobilization of the bladder so that it can be drawn down low enough to create a tension-free anastomosis with the urethral remnant. Freeing the urethral remnants from their adherence to the pubic bone may require a suprapubic incision with dissection from above in order to accomplish this. In such cases Moir took care to reinforce the bladder neck with buttressing sutures, and generally brought in a Martius' graft for better support and a renewed blood supply.

If only the posterior portion of the urethra had been sloughed and the anterior portion of the urethra was intact, Moir (Moir 1964) advocated a different technique for urethral reconstruction. In this technique, a thin catheter was stitched into position to serve as a splint for the new urethra. The margins of the urethral bed were freed from the vagina and were mobilized to allow them to be pulled together over the underlying catheter without tension. The vaginal incision was extended above the bladder neck and then reinforced with "inrolling stitches." The repair was usually buttressed with a Martius bulbocavernosus fat graft, after which the vagina was closed over the repair with vertical mattress sutures to achieve a "broad apposition" of the vaginal wall. The bladder was then drained for 10 days and the vaginal sutures were removed after 21 days. Although he reported good success with this technique, with 23 of 34 women (67%) having "perfect or near perfect control" six months after surgery, 8 of 34 (24%) had persistent stress incontinence, and 9% had no improvement, reconfirming the view that persistent stress incontinence remains a significant problem for many women after successful fistula closure. Similar techniques with similar results have been reported by other authors (Noble 1901; Symmonds 1969; Symmonds and Hill 1978).

Various authors have described neourethral reconstruction using bladder flaps (Barnes and Wilson 1949; Flocks and Culp 1953; Su 1969; Quartey 1972; Tanagho and Smith 1972). All of these operations are based upon transabdominal techniques; however, a transvaginal approach to neourethral reconstruction using an anterior bladder flap technique was described by Elkins, Ghosh and co-workers (Elkins, Ghosh et al. 1992) In this technique, a neo-urethra is created by mobilizing a flap from the

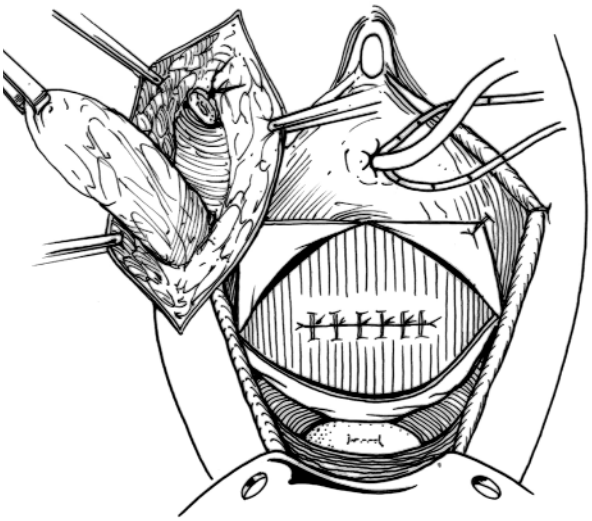

Figure 24. Martius flap. The superior aspect of the graft is gently grasped with an Allis forcep and the labial fat is further mobilized down to its base, which is left intact to maintain its blood supply. (©Worldwide Fistula Fund, used by permission).

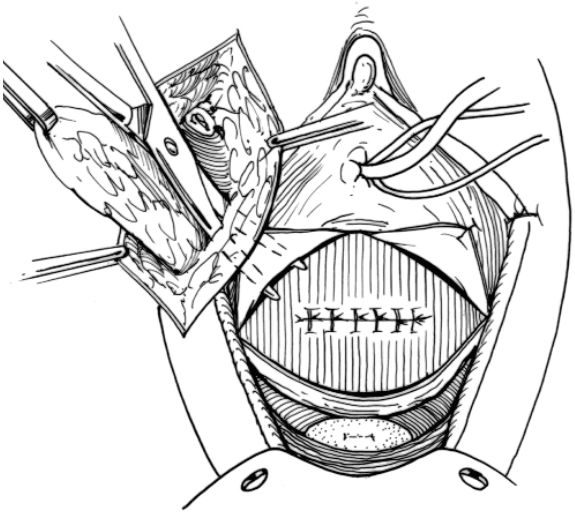

Figure 25. Martius flap. A tunnel is dissected from the base of the labial fat graft into the vagina, running between the vaginal epithelium and the pubic arch. (©Worldwide Fistula Fund, used by permission).

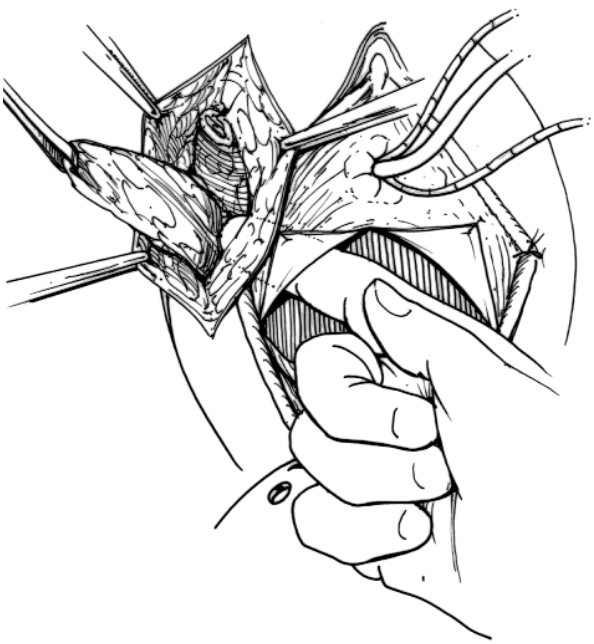

Figure 26. Martius flap. The final caliber of the tunnel should be large enough to allow passage of the surgeon's finger from the labial defect down to the bladder base. (©Worldwide Fistula Fund, used by permission).

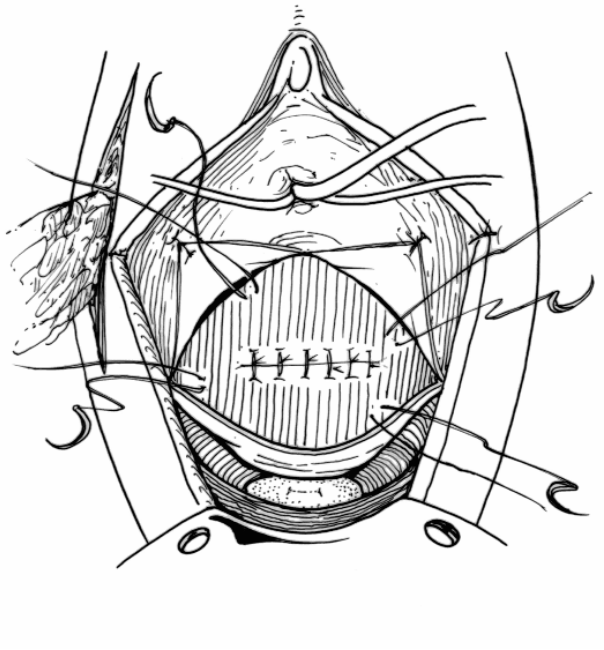

Figure 27. Martius flap. Prior to passing the graft through the tunnel, four anchoring stitches of absorbable material are placed into the muscularis of the bladder at the 2, 4, 8, and 10 o'clock positions. (©Worldwide Fistula Fund, used by permission).

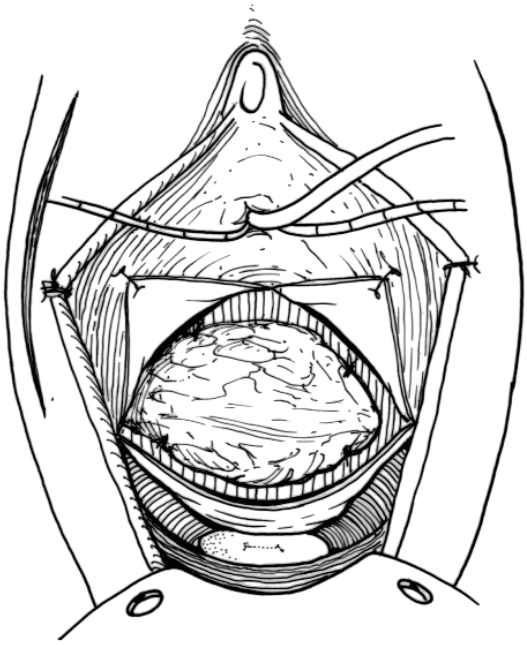

Figure 28. Martius flap. The graft is then brought through the tunnel and anchored securely into place against the repaired fistula. The site of fistula repair should be completely covered at this point. (©Worldwide Fistula Fund, used by permission).

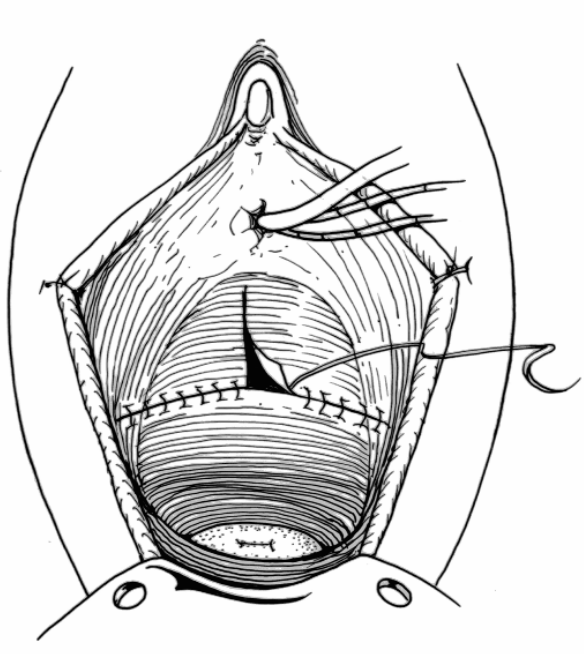

Figure 29. Vaginal closure. The stay sutures holding the vaginal flaps are released and the vaginal defect is closed as an "inverted T" using absorbable sutures. (©Worldwide Fistula Fund, used by permission).

anterior bladder, which is then rolled into a tube. In this technique, the anterior and lateral edges of the fistula are freed up and the space of Retzius is entered transvaginally beneath the pubic bone. The anterior bladder is then pulled down into the vagina and mobilized. A 3 cm incision is made into the bladder and the anterior bladder wall is then rolled around a 16 Fr. Foley catheter to create a tube. After this is tacked down, a similar incision is made on the other side to complete mobilization of the tube. The anterior surface of the neourethra is then sutured in two layers and the posterior edge of the fistula is closed transversely, also in two layers. The neourethra is reattached to the posterior edge of the pubic symphysis, and a Martius graft is placed, before reapproximating the vaginal epithelium. This technique resulted in successful closure of the fistula in 18 of 20 cases, 4 of whom had severe stress incontinence post-operatively.

Based on their extensive experience with fistulas in Addis Ababa, Ethiopia, in 1969 Hamlin and Nicholson introduced the concept of the "difficult urinary fistula" to describe the complicated aspects of the problem touched on by Moir. According to them (Hamlin and Nicholson 1969), the "difficult fistula"

> "…is a complex of several grave injuries occurring together—-namely, a) total destruction of the urethra (all walls), the remaining tissue being merely fibrous connective tissue and squamous epithelium which has grown over and become adherent to the periosteum on the back of the pubic bones; b) an extensive sloughing of the bladder neck and trigone sometimes so large as to cause one or both ureteric orifices to open directly into the vagina; and c) fibrosis to an incredible degree which 1) narrows the vagina to the diameter of one fingerbreadth, and 2) binds the remains of the bladder high up to the descending pubic rami and to the pubic symphysis. In a word, no part of the patient's lower urinary tract has escaped some degree of damage. This is the fistula which daunts the hearts of most observers who see it for the first time. … The gynaecologist bold enough to attempt the classical flap-splitting operation for a case like this soon discovers that he is operating in an area as confined and almost as inaccessible as the inside of the toe of a leather shoe. He will find himself freeing the bladder of scar and the lateral fixation of its torn edges by touch only. … Within the vagina nothing exists … except, almost quite literally, skin and bone."

In such cases, Hamlin and Nicholson recommended constructing a new urethra by creating a new "inner" urethra using the skin and fibrous connective tissue covering the pubic bones and the inferior border of the pubic symphysis. In this technique, two lateral vertical incisions about 2 cm part are made in the skin, and left and right skin flaps were then created and reflected medially until their edges could be joined together without tension in the midline underneath the urinary catheter that had been placed in the bladder. When joined, these fragile skin flaps are rolled into a tube. At this point the neourethra is a fragile, untenable creation. As the authors noted, "Such a fragile neourethra, standing unsupported, would almost certainly necrose, and even if it survived would not restore any worthwhile degree of function." The neourethra was then reinforced using a gracilis muscle flap taken from the thigh, preserving its neurovascular pedicle. The gracilis tendon is pulled through a tunnel in the thigh that crosses the ischiopubic ramus at the level of the urethra and is guided into the vagina, under the pubic symphysis, and is sutured to the anterior lip of the cervix, the lateral vaginal fascia, and the fibrous connective tissue covering the periosteum of the ischiopubic rami and the pubic symphysis. Once this has been accomplished, additional grafting is necessary using a Martius flap which is then covered with skin flaps.

Using this technique, the authors reported no deaths and only one "complete failure" in 50 operations, this case being due to failure of the blood supply to the gracilis muscle flap. In some cases small urethrovaginal fistulas remained, which were repaired at a subsequent operation. Surprisingly, only 8 women (16%) developed "severe" stress incontinence after this reconstruction, four of whom regained "satisfactory" continence over time, and four of whom required an operation for stress incontinence. In the latter four patients, only two of these operations were completely successful. Six patients (12%) developed a urethral stricture, three of which were successfully treated by passage of a sound and three of which required surgical correction. The remaining 35 patients (70%) were discharged home within six weeks of surgery cured or with mild residual stress incontinence which did not appear to be clinically bothersome for them (Hamlin and Nicholson 1969).

Recently Browning (Browning 2004) described a technique for urethral buttressing that could be carried out at the time of initial fistula repair, particularly in patients with urethrovaginal or bladder neck fistulas who are at high risk for persistent post-operative stress incontinence. The operation involves mobilization of a small strip of the ischiocavernosus muscles (or their fibrotic remnants) along each side of the urethra, then suturing them together in the midline under no tension to create a fibromuscular sling under the repaired/reconstructed urethra. A Martius fat graft was then created and sewn over the sling and site of the repair to improve vascularization and healing of the repair. In this small series of 32 complicated patients on whom this procedure was performed in 2002-2003, 22 of 32 were continent, the failures occurring in patients with small bladders and/or severe vaginal scarring.

There is little information on subsequent treatment of stress incontinence following successful fistula closure. A standard Burch-type retropubic bladder neck suspension operation, combined with urethrolysis and tissue plication, may work in a few patients (Waaldijk 1994), but in general the results of this approach have been very disappointing. Carey and co-workers reported a small series of patients who had undergone previous fistula closure and who later underwent re-operation for stress incontinence. After urodynamic testing, 9 women with severe genuine stress incontinence underwent a retropubic urethrolysis and a pubovaginal sling procedure combined with placement of an omental J-flap. Four weeks after surgery, 78% were continent; however, this fell to 67% at 14 month follow-up (Carey, Goh et al. 2002).

The unstated assumption in all these surgical experiments has been that post-repair stress incontinence in fistula patients is a variant form of intrinsic sphincter deficiency and should, by extension, be treated similarly. Simply stated, however, we have almost no scientific understanding of why stress incontinence occurs after successful fistula closure because we have virtually no scientific data on this problem. Is it due to massive urethral damage? Is it due to necrosis of the puborectalis muscle complex and damage to the fascial "hinge" that connects the periurethral tissues to the muscle along the urethra and at the bladder neck? Is it due to disruption of the neural control mechanisms that modulate sphincter function? Is it due to unusual changes in transmission of intraabdominal pressure to the urethra and bladder neck which are peculiar to patients who have undergone prolonged obstructed labor? Until we have a better scientific understanding of the urethral pathology that develops due to obstructed labor, we will not understand how to deal with the stress incontinence that results. The attempts so far to solve the problem of persistent

stress incontinence in post-repair fistula patients have been uncontrolled empirical surgical experiments with rather poor outcomes. We can, and should, do better than this.

2. Urinary Diversion for the Irreparable Fistula

Although there is a general consensus in the literature that some fistulas simply cannot be repaired with restoration of full continence, there is no general agreement as to which fistulas should be treated initially by primary urinary diversion rather than an attempt at fistula closure. Similarly, there are no accepted criteria in failed cases to dictate when further attempts at closure should be abandoned and the patient should be offered some form of urinary diversion as a treatment. The dilemma has been summarized by Hodges (Hodges 1999):

> Many centres which perform VVF repairs have a small group of "problem" patients who have failed to gain continence despite often repeated attempts by different surgeons. Urinary diversion, with all its disadvantages, is seen as an admission of defeat by the VVF surgeon and so this decision is reached reluctantly. This reluctance is compounded by the concern of performing such a major procedure in often basic conditions. However, in the best interests of the patient, eventually the experienced VVF surgeon must admit when all attempts to gain continence have failed and consider urinary diversion."

Because urinary diversion tends to be a "high technology" approach to fistula management, its use in countries that do not have a well-developed nursing infrastructure to support the ongoing care of such patients suggests that this technique should be used with extreme caution. For example, transplantation of the ureters into an ileal conduit requires the use of an external collecting device. The use of such appliances may well be unacceptable in the local culture and patients are likely to experience significant difficulty in obtaining suitable external appliances and may have trouble performing good stoma care. The result of such a policy could well be simply to transpose the fistula from the vagina to the abdomen! Likewise, if continent urinary diversions are performed with the creation of a catheterizable stoma, the problem of clean intermittent self-catheterization remains. This can be compounded by loss of the catheter or the development of stomal stenosis, with urinary retention, reservoir breakdown, sepsis, and death. Hodges (Hodges 1999) has reported a series of seven patients with intractable fistulas who were treated in Uganda by continent urinary diversion using a Mitrofanoff procedure in which the appendix is mobilized as the catheterizable stoma. There was one death 6 days after surgery, apparently from coincidental complications rather than as a direct result of the operative technique. The other six patients were reported as doing well up to 14 months after surgery. Because of the possibility of the complications already alluded to, "patients are encouraged to remain near a hospital which can deal with any likely complications; five of the six patients have taken this advice. All patients carry spare catheters and a letter clearly explaining the nature of the procedure and the emergency treatment if there is a complication." Whether these arrangements would be suitable for employment in different environments in other countries remains unknown.

The "traditional" operation for dealing with the irreparable fistula has usually been uretero-sigmoidostomy in which the ureters are transplanted into the sigmoid colon, which then functions as a reservoir for both urine and feces. The long-term consequences of this operation, such as anastomotic leakage with peritonitis, ureteral stenosis and hydronephrosis, acute and chronic pylonephritis, electrolyte imbalances, diarrhea, long-term renal failure, and the development of adenocarcinoma of the colon at the site of ureteral implantation, are well-known. These complications should give compassionate surgeons pause before recommending operations of this kind.

Several small series of fistula patients who have undergone ureterosigmoidostomy have been reported in the literature (Foda 1959; Humphries 1961; Attah and Ozumba 1993), including one patient who became pregnant and delivered a live infant following an emergency Cesarean section for a bleeding placenta previa (Lassey, Peterson et al. 2002). These series are somewhat difficult to evaluate, as the numbers of patients reported are small and follow-up is often unsatisfactory. For example, Das and Sengupta (Das and Sengupta 1969) resorted to urinary diversion and ureteral transplantation in 20 of 135 fistula patients that they reported in one series from India. Of these patients, two died of uremia after the surgery—one of the 9th and one on the 21st post-operative day after a stormy post-operative course. They did not know the follow-up of the other patients. Case fatality rates as high as 38.5% have been reported following these procedures in developing countries

(Thompson 1945); although such grim statistics tend to come from the older surgical literature, the conditions of surgical practice and the facilities available for patient care may not have changed appreciably in those countries in which fistulas are still prevalent.

In recent years it has been discovered that many of the disadvantages of "classical" ureterosigmoidostomy could be overcome by modifications of technique, the so-called "Mainz II" pouch (Fisch, Wammack et al. 1993; Gerharz, Kohl et al. 1998). In this modification the anterior colon is opened 12 cm distal and proximal to the rectosigmoid junction, and a side-to-side anastomosis is made. This detubularization of the bowel reduces the force of colonic contractions and creates a "low pressure" system that does not appear to predispose such patients to the development of hydronephrosis. The bowel is attached to the sacral promontory for stabilization, and the ureters are mobilized bilaterally and transplanted into the colon through a 4-5 cm submucosal tunnel on each side. Aside from the continuing need to monitor such patients for the development of hyperchloremic metabolic acidosis and the possibility of the growth of malignant polyps at the uretero-colonic implantation site, patients undergoing the Mainz II procedure have done quite well, and almost all have had socially acceptable urinary continence and improved body image compared to patients undergoing urinary diversion using an ileal-conduit.

Good long-term follow-up studies of patients who have undergone urinary diversion of this type for irreparable fistulas in developing countries are virtually non-existent. If ureterosigmoidostomy is contemplated for a fistula patient, it is essential that she has normal anal sphincter control pre-operatively. This can be assessed by giving a large volume enema as a continence test to see how long she can retain it. It is also essential that patients be given enough time and counseling to understand the possible consequences of this type of surgery for their lives and future health. Treatment of intestinal parasites and a thorough bowel-prep prior to surgery are obvious essential components of this type of therapy. The optimal use of such techniques in fistula patients remains to be determined; however, it is clear that "salvage therapy" of this type will continue to have a place in the treatment of some patients with obstetric fistulas for many decades to come.

IX. PREVENTION OF OBSTETRIC FISTULAS

The ultimate strategy for dealing with obstetric fistulas should be to prevent them entirely. Indeed, this is precisely how the Western world solved the problem within its borders. Because obstetric fistulas are tied closely to overall maternal mortality, the best way to reduce fistula formation is to provide essential obstetric services at the community level with prompt access to emergency obstetric services at the first referral level. The success of this strategy has been amply demonstrated by Loudon (Loudon 1992; Loudon 1992), by Maine (Maine 1991) and the essential elements of such obstetric care have been elaborated in some detail by the World Health Organization (WHO 1986). **Figure 30** shows the historical trends in maternal mortality in the United States, England and Wales, and the Netherlands since 1920 (Loudon 1992). At the beginning of the 20th Century, maternal mortality in Western Europe and North America was similar to that which currently exists in the developing world. The introduction of antibiotics, blood transfusion, safe Cesarean section, better transporation and improved access to care, along with the professionalization of obstetric care and midwifery services, led to a dramatic and continued decrease in maternal mortality in all these countries (Loudon

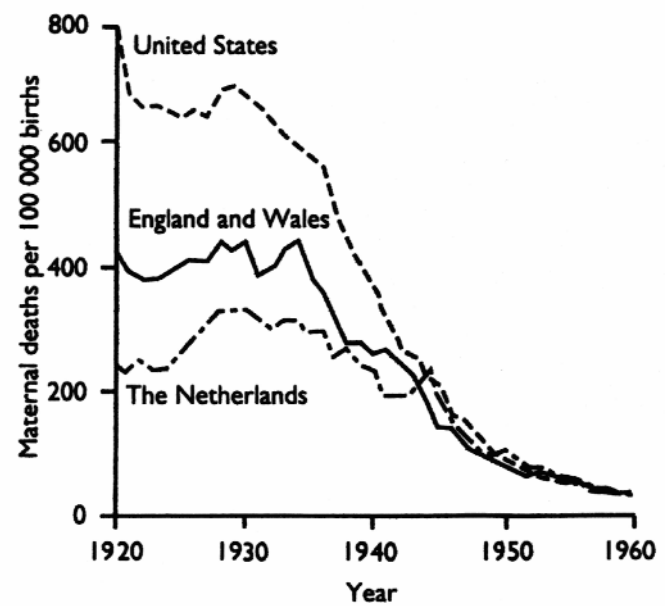

Figure 30. Historical trends in maternal mortality in the United States, England and Wales, and the Netherlands, 1920 - 1960. (Loudon 1992a).

1992; Loudon 1992; Loudon 2000). During the same period the obstetric fistula virtually vanished from the experience of the industrialized world. Elimination of obstetric fistulas from the developing world will require that their health care systems undergo a similar transformation.

The committee believes that the fundamental components of such a program include the following:

- Promotion of breastfeeding and the elimination of childhood infections which hamper growth, such as gastroenteritis, respiratory infections, along with immunization against the six "killer diseases" of childhood: measles, diphtheria, tetanus, polio, pertussis, tuberculosis.
- Adequate childhood nutrition to allow young women to achieve full pelvic growth before childbearing begins
- Delay in childbearing until full pelvic growth completed. There is substantial evidence to suggest that education is the best way to shelter girls from premature childbearing.
- Provision of family life education, education about women's health and sex education to adolescents.
- Elimination of traditional customs that promote early marriage. While respect for the principle of individual autonomy would argue for the elimination of early betrothal and arranged marriages, even in cases where such practices continue there should be a mutually-understood and agreed-upon delay in the consummation of such marriages until the young woman has reached full pelvic maturity. There is no advantage to any community in having early adolescent pregnancies.
- Supervision of the labor of every pregnant woman by a trained birth attendant. For developing countries this requires a commitment to developing culturally-acceptable community midwifery programs and an expansion of midwifery training services everywhere.
- Monitoring of every labor with the use of partograms to detect cephalo-pelvic disproportion early and to prevent the development of obstructed labor. There is overwhelming evidence that simple technology can accomplish this goal (Kwast 1994).
- Prompt, universal access to emergency obstetric care at the first referral level. This should be a fundamental goal of every health care system in the world. This will require removal of cultural and institutional, as well as physical, barriers (Maine 1991; Thaddeus and Maine 1994; Network 1995).
- Universal basic education for women. There is substantial evidence that the education of women plays a major role in promoting maternal health, reducing maternal mortality, and eliminating obstetric fistulas (Harrison 1985; Harrison 1997). These goals appear to be achieved largely through better access to and utilization of life-saving health care services; however, it must be emphasized that for education to be effective in achieving these goals, effective health care services must first exist. Maternal mortality, and with it obstetric fistula formation, is largely a problem of the world's poor: the affluent countries of the world bear substantial responsibility for allowing this situation to continue when relatively low cost, low technology interventions exist that could prevent it (Rosenfield and Maine 1985; Weil and Fernandez 1999).
- Finally, education of men concerning the importance of women's reproductive health for their own families in particular and for the community at large. Because men control a disproportionate share of social resources everywhere, but especially in developing countries, they must understand that "women's health" is not "just a women's issue," but is one in which they too must become intimately involved.

X. DEALING WITH THE BACKLOG OF SURGICAL CASES

The WHO Technical Working Group on the prevention and treatment of obstetric fistulas which met in Geneva from April 17-21, 1989 naively suggested that a plan could be put forth by which the backlog of existing fistula cases could be cleared up within five years (WHO 1989). Greater experience now suggests that solving the problem of cases awaiting surgery will require a generation or more. Not only is the backlog of unrepaired cases huge, but the absence of adequate maternal health care and emergency obstetrical services means that large numbers of new cases are continually occurring in those parts of the world where the fistula problem is greatest, thus adding continually to the burden of injury, which is not diminishing.

The special nature of the injuries produced by obstructed labor, the stigmatizing and socially isolating nature of the injury, and the long periods of rehabilitation needed before operation and the length of nursing care required after surgery, strongly argue in favor of the creation of specialized fistula centers in areas of the world where fistulas are highly prevalent. Ideally, each country or region in which this problem exists should have its own dedicated center, and centers in neighboring countries should be encouraged to collaborate in sharing information and establishing common protocols for research and training. There is an urgent need to create an international network of fistula centers in the developing world that can collaborate with one another in advancing the care of patients who have sustained an obstetric fistula.

Why are specialized fistula units needed? The first argument is the efficiencies obtained from "economies of scale." A "focused factory" that does nothing except repair fistulas and take care of the related problems stemming from obstructed labor will develop special expertise in managing those problems. Such a center can deal with more cases more efficiently than a smaller service attached to a general hospital. Such a center also allows for the concentration of a sufficient volume of cases for meaningful training programs to be established through which additional fistula surgeons and fistula nurses can be developed for other centers in developing countries.

Second, the large volume of existing cases in developing countries justifies this approach in terms of the sheer numbers of patients involved. The Addis Ababa Fistula Hospital in Ethiopia, for example, has repaired approximately 25,000 cases to date, and still there is no shortage of women needing services.

Third, fistula units in general hospitals must compete for scarce resources with the needs of the general medical and surgical population. Since fistula repairs are rarely emergencies, it is difficult to book and keep scheduled operating theater time in the face of ongoing emergencies such a road traffic accidents, incarcerated hernia, intestinal perforations from typhoid or parasites, women in obstructed labor who need a surgical delivery, and so on. In settings where the health care system is already overwhelmed and where resources are scarce, scheduled fistula repairs are continually getting "bumped" from the operating schedule by more acute emergencies. While this is perfectly understandable, it augurs poorly for the development of an efficient fistula service in such a setting. Furthermore, because fistula patients traditionally have required two weeks of post-operative care for catheter drainage, they are more "bed intensive" than other surgical cases. In Lavery's (Lavery 1955) series of 160 obstetric fistula cases from South Africa, the average duration of stay in hospital was 57.3 days, with a range of 11 to 264 days. In an environment with constant pressure to turn over hospital beds more quickly, fistula patients are likely to receive short shrift.

Fourth, fistula patients tend to integrate poorly into general hospital wards. By the time most such patients arrive for surgical treatment, they have been cast out and stigmatized by the society in which they live. They are psychologically and spiritually vulnerable, and they are socially offensive due to the odor that surrounds them. Many of these women are further stigmatized by unwarranted beliefs about why they developed a fistula in the first place: it is assumed by many to be a punishment for some offense against God (such as a pregnancy originating in an adulterous relationship) or as the result of a hideous venereal disease, which some consider contagious. Fear of the unknown breeds hostility towards these patients in the community at large.

Fifth, for reasons cited above, these patients do better in a communal environment. It is a great psychological relief to fistula patients to realize that they are not alone, to meet fellow sufferers with whom they can share experiences. A "sisterhood of suffering" develops in a dedicated fistula center that is immensely beneficial in restoring psychological health and hope to these women. At the Addis Ababa Fistula Hospital, most of the nursing care is provided by former fistula patients, who provide a level of empathetic nursing unequaled anywhere in the world.

It seems unlikely that large, dedicated fistula centers similar to that which exists in Addis Ababa will be developed in every country where there is great need within the foreseeable future. What then can be done? For the reasons enumerated above, it is important that facilities be created that are dedicated exclusively to the care of women with obstetric fistulas. Such facilities need not be identical everywhere; their capabilities could be stratified into those capable of dealing with "simple" cases, and those dealing with more complicated "high risk" fistulas (Elkins, Mahama et al. 1994).

Hamlin and Nicholson's concept of the "difficult" fistula has already been alluded to (Hamlin and Nicholson 1969). It is unrealistic to expect (and undesirable to encourage) a neophyte fistula surgeon

to tackle cases of this complexity in a small, low volume fistula unit. However, the majority of obstetric fistulas seen in developing countries are not this complicated, and the size of the fistula has little bearing on the degree of urinary incontinence and resulting disability that the affected woman experiences: The same amount of urine runs out of an unscarred, freely mobile, 1 cm mid-vaginal fistula as runs out of a 5 cm fistula in which the bladder neck and proximal urethra have been destroyed, the vagina stenosed, and the fistula scarred against the pubic symphysis in dense bands of fibrosis. A relatively unskilled fistula surgeon could easily fix the former, restoring continence and hope to the afflicted patient, whereas he or she would likely get into serious difficulties in an attempt to operate on the latter.

Elkins and Wall (Elkins and Wall 1996) have demonstrated that trained obstetrician-gynecologists and general surgeons can quickly become proficient with the basic principles of fistula surgery if they are given appropriate training and supervision through an intensive "short course" in fistula repair: it does not take years of additional training to create capable fistula surgeons. Although such trainees may not be fully able to tackle difficult or "high risk" cases, they can certainly close the less complicated fistulas (Hamlin and Nicholson 1969; Elkins, Mahama et al. 1994). What is required in order to achieve this level of skill is an adequate volume of surgical cases that can be done under supervision while the basic techniques are mastered. Thus, it does seem feasible to create a "tiered" system of fistula centers within countries where that need exists. The key to making such programs work is trained, committed personnel who have adequate local resources. Small programs can be started with a few dedicated beds in a general hospital. If additional resources are provided, such programs can expand to occupy a dedicated ward at the same facility. Ultimately, the program can become transformed into an entirely separate facility dedicated exclusively to the care and rehabilitation of fistula patients.

The following recommendations can be made for the creation of specialized fistula centers in developing countries:

- For the reasons outlined above, the creation of dedicated fistula centers should be encouraged.
- Fistula centers should be located close to an all-weather road and good public transportation to facilitate access by patients. Wherever possible, such centers should be located in the geographic region in which fistulas are most prevalent, rather than in capital cities which have few fistulas and which therefore require patients to travel long distances to obtain care.
- Fistula centers should be located reasonably close to a general hospital so that emergency cases can be referred elsewhere, thus protecting the overall mission of the fistula program.
- Each fistula center should have a dedicated operating theater, ideally one in which two or more operations can be carried out simultaneously to maximize the turnover of cases.
- An in-patient ward of adequate size should be provided to deal with the expected number of cases. A ward of 40 or 50 beds should allow 500 to 1,000 operative cases to be treated each year.
- A "step-down unit" or hostel should be located at the fistula center to allow for pre-operative nutritional and educational support for fistula victims, and to allow better post-operative monitoring of non-acute patients.
- Care for fistula patients should be provided free of charge as a matter of principle. Fistula victims overwhelmingly tend to be young, poor, uneducated women, often deserted by husband and family, and from rural areas. There are many tragic stories of women who have suffered with fistulas for decades because they were unable to scrape together bus fare to a hospital or the cost of surgical supplies. Many studies of health care in developing countries have demonstrated that the institution of "user fees" dramatically reduces the utilization of services, often with worsening health outcomes (Ekwempu, Maine et al. 1990; Network 1995). The total cost of supplies and services for fistula repair is generally quite modest ($250 - $400). Although this still represents a large expenditure in developing countries, set against the value obtained from giving a woman back her life, it represents excellent cost-effective treatment. In order to bear these expenses, most fistula centers will probably require some degree of external funding through international medical aid; efforts in this direction should be encouraged. As the famous British surgeon Lawson Tait wrote in 1889 (Tait 1889), "I have already said that operations for vaginal fistulae are rarely paid for, except in gratitude, because the patients are nearly always poor. I must have operated on two or three hundred cases, and I have not yet been remunerated to an extent which would pay for the instruments I have bought for the purpose."

- Fistula centers will require an on-site kitchen and laundry facilities. In African general hospitals, many of these services are typically provided by the family and relatives of the patient. The nature of the injury sustained by fistula victims means that many have been abandoned and lack this fundamental resource for coping with their condition. Fistula centers should therefore be prepared to provide the essentials of nutrition and laundry. Due to the vagaries of water and electric power in developing countries, fistula centers should have their own diesel generators and self-contained water supply, wherever feasible.
- Facilities and surgical care should be provided within a framework of "low technology" medicine. Almost all surgical procedures can be provided under simple spinal or ether anesthesia using standard surgical instruments, simple suture, and transurethral catheter drainage. Clinical laboratory requirements should be kept to a minimum. Cinder block construction, open wards, sheet metal roofing and simple architecture can be used to keep construction and operating costs to a minimum.
- Adequate housing for doctors and nursing staff should be provided, within the appropriate expectations of the local culture. If current and former patients are trained to work as nursing assistants, they can be housed acceptably in dormitory-style housing.

XI. CONCLUSIONS AND RECOMMENDATIONS

- The precise extent of the fistula problem in developing countries is unknown. The available evidence suggests that at a minimum, hundreds of thousands (if not several millions) of women are afflicted with this condition worldwide, most especially in sub-Saharan Africa. The enormous burden of suffering caused by fistulas is borne principally by young women living under conditions where their opportunities for education, economic prosperity, self-determination, and "the pursuit of happiness," are limited by poverty, illiteracy, restricted social roles, the absence of adequate reproductive health services, and political disenfranchisement. Fistulas are primarily a condition that afflicts society's "have nots," and the prevalence of obstetric fistulas closely tracks world maternal mortality statistics, especially in those areas where obstructed labor is a principal contributing cause of maternal death. The continued prevalence of obstetric fistulas represents a tragic waste of some of the most precious of the world's human resources: its young women.
- In theory, obstetric fistulas are completely preventable by the provision of adequate, timely obstetric care. The presence of obstetric fistulas in any country, therefore, is an indictment of the quality and effectiveness of its health care delivery system. When obstetric fistulas do occur, they should be curable ("closeable") in over 90% of cases using appropriate low-technology medical and surgical services.
- The fistula problem has been shamefully neglected by the governments of those countries in which they occur, by local health services, by non-governmental organizations, by international health organizations such as WHO, and by the foreign aid and international development agencies of the world's wealthy countries. The fistula problem has been almost uniformly neglected by the world's "Safe Motherhood" initiative, which itself has been largely ineffective in reducing maternal death in developing countries. The fistula problem has been, and still is, an "orphan." This situation is intolerable, and must be changed. There are faint signs that the world is finally recognizing this situation, but the response to date has been woefully inadequate (Donnay and Weil 2004).
- There is a great need for village-based community studies of the incidence and prevalence of obstructed labor and fistula formation. It is clear that most fistulas arise from the combination of "obstructed labor and obstructed transportation," but much more work is needed to understand the social context in which obstetric emergencies arise and how they are dealt with in developing countries. Nonetheless, the urgent needs of pregnant women should not be sacrificed on the altar of epidemiological research; rather, more attention should be paid to improving emergency treatment for obstetric complications at existing referral facilities, to upgrading peripheral facilities to provide

essential life-saving obstetric care, to educating the community about the danger signs of obstetric complications, and to working with community leaders to improve access to emergency obstetric care in areas where maternal mortality and obstetric fistula rates are high.

- There is no standard classification system for obstetric fistulas. The committee recommends that the ICS take this task upon itself and that a subcommittee of the committee on the standardization of terminology by appointed to begin dealing with this task.
- Although the solution to the fistula problem will ultimately come from the provision of essential obstetric services for all the world's women, the current needs of those women who have already developed an obstetric fistula cannot be ignored. The committee recommends that specialized fistula centers should be created in all countries where obstetric fistulas are prevalent. Women with fistulas should have access to prompt, high quality surgical reconstruction which should be provided free of charge. Such facilities should serve as centers of compassionate excellence and should provide high quality patient care, medical and nursing education, and clinical research as part of their mandate for existence. It is unlikely that essential obstetric services will be available to all of the world's women within the foreseeable future; therefore, development of a sustainable clinical infrastructure to deal with the effects of maternal morbidity is likely to be an essential need in reproductive medicine for the rest of the 21st Century.
- Although current surgical techniques consistently result in fistula closure rates of 80% - 95% of cases, there has been almost no scientifically rigorous research carried out on most of the persistent technical surgical questions raised by fistulas. Urgent work is needed in this area. Among the issues that should be addressed are:

1 The problem of persistent stress incontinence after successful fistula closure;

2 The management of dramatically reduced bladder capacity in patients with large fistulas who have undergone successful closure;

3 The best technique for rectovaginal fistula repair;

4 The role of urinary diversion for the "incurable" fistula, usually involving some form of ureterosigmoidostomy;

5 The role of vaginoplasty in patients with vaginal atresia from obstructed labor;

6 The best method of caring for patients who present with a "fresh" fistula a few days or weeks after delivery, including the role of early repair in selected obstetric fistulas;

7 Future reproductive function in patients who have sustained an obstetric fistula;

8 The proper role and choice of flaps and grafts in fistula surgery;

9 The optimum duration of post-operative bladder drainage after fistula repair;

10 The role of nutritional support in improving the outcomes of patients with obstetric fistulas; and

11 The role of physical therapy and reconstructive orthopedic surgery in the management of women with obstetric foot-drop from prolonged obstructed labor.

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