Best Age for Male Circumcision: A Literature Review

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ABSTRACT

**Background:** Circumcision is a common surgical procedure, but regional and societal attitudes differ on whether there is a need for a male to be circumcised and, if so, what age is best. This is an important issue for many parents, but also pediatricians, other doctors, policy makers, public health authorities, medical bodies, and males themselves.

**Discussion:** We show here that infancy is an optimal time for clinical circumcision because an infant's low mobility facilitates the use of local anesthesia, sutures are not required, healing is quick, cosmetic outcome is usually excellent, costs are minimal, and complications are uncommon. The benefits of infant circumcision include prevention of urinary tract infections (a cause of renal scarring), reduction in risk of inflammatory foreskin conditions such as balanoposthitis, foreskin injuries, phimosis and paraphimosis. When the boy later becomes sexually active he has substantial protection against risk of HIV and other viral sexually transmitted infections such as genital herpes and oncogenic human papillomavirus, as well as penile cancer. The risk of cervical cancer in his female partner(s) is also reduced. Circumcision in adolescence or adulthood may evoke a fear of pain, penile damage or reduced sexual pleasure, even though unfounded. Time off work or school will be needed, cost is much greater, as are risks of complications, healing is slower, and stitches or tissue glue must be used.

**Summary:** Infant circumcision is safe, simple, convenient and cost-effective. The available evidence strongly supports infancy as the optimal time for circumcision.

**Keywords:** Circumcision, Surgery, Local Anesthesia, Foreskin, Sexually Transmitted Infections, Infancy.

1. **INTRODUCTION**

Circumcision is an operation to remove the foreskin that covers the tip of the penis. The functions of the foreskin include protecting the head of the penis and contributing to sexual sensations. Male circumcision (MC) is perhaps the oldest, most common and most controversial surgical procedure world over [1,2,3]. It is usually carried out largely for cultural and religious reasons. Other indications are for hygienic benefits, treatment of phimosis, paraphimosis, prevention of penile and cervical cancers, urinary and sexually transmitted infections including human immunodeficiency virus (HIV) [1,2,3,4].

Worldwide 1 in 3 males are circumcised [5,6], totaling an estimated 1.2 billion [6]. The coverage of male circumcision is almost universal in some settings, while the prevalence is very low in others [7]. In the USA, medical MC is performed on 1.2 million newborns (56% of baby boys) in community hospitals annually [8,9]. The true number is higher because some boys are circumcised in ambulatory facilities, a physician's clinic or in a private home. In other developed countries infancy is also the most common time for performing MC, whereas in non-Muslim developing
countries, MC is usually part of coming-of-age ceremonies where risks are usually greater [10]. The largest number of circumcised males are Muslims (approx. 70% of circumcised males globally) [5]. The prevalence of male circumcision in the Eastern Nigeria likely exceeds the World Health Organization’s reported figure of 90% for Nigeria, with majority of these being carried out for cultural and religious reasons [1,2].

Circumcision predates human history, with evidence of MC from art forms of the Upper Paleolithic period in Europe [11]. Rather than arising independently in diverse cultures globally [12], the practice more logically arose prior to the migration of Homo sapiens out of Africa [13]. If it had no survival advantage, it is unlikely that it would have persisted, and, as hypothesized by Cox & Morris, subsequent cessation of MC in some populations was perhaps a result of behavioral changes caused by environmental stressors or new religious philosophies such as Hinduism and Buddhism [13]. Such factors could explain why circumcision is relatively low in European, South and Central America, southern Africa, and non-Muslim Asian countries. The awareness during Victorian times of a wide array of medical benefits from MC, including prevention of syphilis and better hygiene, led to a rise in its popularity in Anglo-Saxon populations in the 19th century [12,13], continuing today in the USA in particular, where the majority of infant boys are circumcised [8,9]. In the UK, circumcision is more common in the wealthier upper-classes, marking the fact that a doctor attended the birth rather than a mid-wife.

The advent of the AIDS epidemic in the 1980s re-focused interest on MC as a means of prevention of not just HIV, but other sexually transmitted infections (STIs) and adverse medical conditions. This has led to MC programs in high-HIV prevalence settings of sub-Saharan Africa focused on men for more immediate reductions in HIV incidence, but considerable interest has also been given to encouraging infant MC for longer-term gains [14,15]. There have as well been recent calls for the promotion of infant MC in the USA [16,17], the UK [18], Australia [19] and sub-Saharan Africa [20,21].

There are various methods of performing newborn circumcision which include the traditional free hand technique, dorsal slit method, use of bone cutters and the use of clamp devices which includes; Mogen clamps, Gomco clamps and plastibells. The use of plastibell is widely preferred and practiced due to its ease of performance, safety and short duration of procedure [22,23,24].

Most male circumcisions are carried out during the newborn periods and infancy [2,24,25]. This underscores the role of parents and care givers in the decision and choices regarding circumcision of their boys who are minors [26].

Despite the advantages of MC, few studies have directly compared the relative merits of MC at different ages. Here we present our findings after reviewing the literature, and document the relative pros and cons of infant MC versus MC in later childhood, adolescence or adulthood ("later circumcision"). We compare medical and surgical issues for infant versus later MC, attitudes and barriers, psychological issues, as well as cost. Our analysis has relevance to all countries, both developed and developing. Nevertheless, it should be recognized that a decision about circumcision is subject to varying considerations depending on the particular social and cultural context involved.

2. DISCUSSION

2.1 The best time for male circumcision medically

Although a lot of evidence exists about the benefits of MC [16,17,27], it is essential to ask whether these dictate infant MC rather than MC later in life when a boy can make up his own mind [28]. Some of the advantages of MC in infancy were featured in a report arising from an expert consultation conducted by the US Centers for Disease Control and Prevention (CDC) in 2007 [17]. Here we discuss several compelling reasons for infancy being the optimum time for MC.

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An immediate medical benefit is the greatly reduced risk of a urinary tract infection (UTI), which is higher in infancy than any other year of life, and 10 times greater if the infant male is uncircumcised [29]. UTIs are common in uncircumcised infant boys [30] and cause severe pain. Bacteriuria in febrile boys presenting at hospital emergency departments occurs in 36% of uncircumcised boys, pointing to a UTI as the likely cause of fever, compared with only 1.6% of boys who are circumcised [31]. The younger the infant, the more likely and severe the UTI will be, and the greater the risk of sepsis and death [32]. In the still-growing pediatric kidney [30] a UTI can result in permanent kidney damage in 34-86% of cases [33], thus exposing the boy to serious, life-threatening conditions later in life [30], including end-stage renal disease in 10% of cases. In men, risk of UTI is over 5-fold higher if they are uncircumcised [34]. Thus infant MC offers protection against UTI over the lifetime.

Infant MC also offers immediate protection against inflammatory penile skin conditions such as balanitis, posthitis and balanoposthitis that are usually caused by *Candida* spp. Balanitis affected 5.9% of uncircumcised boys in one study [35] and 14% in another [36]. In male dermatology patients, balanitis was present in 13% of those who were uncircumcised compared to 2.3% of the circumcised [37]. Balanoposthitis was a cause of 26% of cases of acquired phimosis [38], in which the foreskin orifice is so narrow that the foreskin cannot be retracted. Lichen sclerosus, a chronic inflammatory dermatosis that results in white plaques and epidermal atrophy, is a disease of the uncircumcised male. It occurs in 35% [39] to 55% [40] of uncircumcised men with type 2 diabetes and peaks in the 30s [41]. Although most effectively cured by MC [41], it would be preferable to prevent it by MC in infancy. Delaying circumcision therefore results in greater exposure of the male to risk of penile inflammation.

Circumcision in infancy also means that by the time the male becomes sexually active, he has partial protection against those STIs known to be more prevalent in uncircumcised men [16,27,42,43]. Meta-analyses of observational studies show MC protects against oncogenic human papillomavirus (HPV) [44], genital herpes (HSV-2) [42], syphilis [42] and HIV [45]. The protective effect is greater when MC is performed prior to sexual debut [42]. In men who have sex with men (MSM), while MC offers little protection against STIs acquired from receptive anal intercourse, MC does appear to protect men who are insertive-only, and to a similar degree as for vaginal heterosexual intercourse [46,47]. If the male is circumcised, his reduced vulnerability to carriage of several STIs means his female partner is less likely to become infected. The female partners of circumcised men are at reduced risk of HPV infection, the main cause of cervical cancer [48], as well as *Trichomonas vaginalis* [49] and bacterial vaginosis [49], *Chlamydia trachomatis* [50], and HIV [51].

MC timing has the same implications for all STIs prevented by MC. If a male becomes sexually active before he is circumcised, he is exposed to a period of increased risk of infection from several STIs. The length of this period varies according to the age at which circumcision is eventually performed. In countries with a high prevalence of STIs, the risk of infection before a male undergoes adult MC may be considerable. Importantly, if a male has been circumcised in infancy or childhood, preceding sexual debut, the issue of infection with an STI during the post-MC healing period does not arise.

The risk of penile cancer is very much higher if a man is uncircumcised [44,52]. Many of the conditions above predispose to penile cancer. For example, meta-analyses found phimosis increases risk of penile cancer 12-fold (8 studies), balanitis 3.8-fold (4 studies) and smegma 3.0-fold (4 studies) [44]. These conditions are more common in or restricted to uncircumcised men. At least half of all penile cancers contain high-risk HPV types [53] and these can be an important predisposing factor [44]. A very conservative meta-analysis noted that there were two-thirds fewer penile cancer cases in men circumcised in childhood [52]. An association found between adult MC and penile cancer could be due to the fact that MC when performed in adulthood is frequently to remove cancerous lesions or to treat conditions such as phimosis and recurring balanoposthitis that themselves are associated with predisposition to penile cancer. Therefore the association does not necessarily imply that delaying MC to adulthood increases the risk of penile cancer. There is also some evidence that MC protects against prostate cancer, a malignancy associated with a history of STIs [44,54].

Arguments that benefits and risks of MC are evenly matched are not supported by an analysis of the frequency of each [55]. Even though MC in adults still provides many benefits, and is currently a crucial intervention in the high-HIV-
prevalence epidemics of sub-Saharan Africa, when considering all of the conditions MC protects against, the benefits of performing this procedure in infancy predominate over later circumcision. When aggregating the frequency of each condition that is higher in uncircumcised males, it has been calculated that as many as half of uncircumcised males will, over their lifetime, require medical attention for at least one of those conditions which MC offers protection against. Thus immediate, as well as assured lifetime protection against a range of adverse medical conditions and infections supports infancy as the optimum time to perform circumcision.

While the medical evidence supports infancy as being the optimum time to circumcise, it is recognized that instituting infant circumcision might present a challenge to individuals in cultures in which circumcision is an important part of coming-of-age ceremonies or that are traditionally opposed to circumcision, particularly in countries in which circumcision is a mark of religious affiliation (e.g., Hindu versus Muslim).

2.2 The best time for male circumcision surgically

Evidence clearly shows that circumcision in infancy carries fewer risks of complications than circumcisions performed in childhood or later in life. In infancy, surgical complications for large published series range from 0.2% to 0.6% [56]. Higher rates of 2-10% have been reported in much older and smaller studies [57]. A recent systematic review found a median complication frequency of 1.5% among studies of neonatal or infant circumcision, compared to 6% among studies of children aged one year or older [58]. Almost all of such complications are minor and can be easily - and completely - treated. In both infants and older children, severe complications (as compared to mild complications) were rare, with a median frequency close to zero [58].

Other desirable features of infant MC are the surgical ease of performing a circumcision on an immobile newborn, the speed of the operation, absence of any need to use sutures, quick healing, and good cosmetic outcome [59,60].

When the frequency and severity of complications from the procedure itself are compared with the frequency and severity of medical conditions, including deaths, that can result from not circumcising, the evidence strongly favors the argument for MC in infancy [61]. Nevertheless, circumcision later is far better than no circumcision at all.

2.3 Parental acceptability of MC in infancy

Despite infancy having a favorable risk-benefit ratio for MC, parents must make the ultimate decision over whether to circumcise infant sons or not. A survey in the USA found that 88% of participants were willing to circumcise an infant son [62]. A review of 13 studies in 9 sub-Saharan African countries found a median of 81% (range 70-90%) of women who would choose to circumcise their infant sons [63]. After an informational session about MC, 74% of men in the Dominican Republic expressed a willingness to have their sons circumcised [64]. In India, a study of women, 78% of whom were Hindu (a religious group that does not traditionally circumcise), found that after being informed about risks and benefits, 81% said they would definitely have their boy(s) circumcised if the procedure were offered in a safe hospital setting, free of charge [65]. Only 1% said they would definitely not have their boy circumcised [65]. In general, when deciding the time it should be carried out, the neonatal period or childhood appears to be more acceptable than MC later.

The reasons for MC given by Australian parents include family tradition, improved hygiene and reduced risk of diseases and other conditions that MC protects against [66]. A study of African-American parents found that 96% strongly believed pediatric circumcision to be healthy, and 73% considered it essential [67]. Interestingly, the study found that it was the mothers who most often made the final decision. Thus there is the need to engage and educate mothers and pregnant women about MC for their infant boys.
2.4 Acceptability of adult MC

MC does have benefits at later ages, but a man must be willing to avail himself of these by getting circumcised. It is therefore important to examine the acceptability of MC by adult males. In the USA, only 13% of uncircumcised heterosexual men indicated that they would be willing to become circumcised to lower their risk of HIV [68]. In sub-Saharan Africa, however, where HIV is an epidemic, an extensive review of 13 studies found that a median of 65% (range 29-87%) of heterosexual men were willing to be circumcised [63]. Men and women in a Kenyan study exhibited a good understanding of the need to maintain safe sexual practices [69]. In India, of 467 uncircumcised heterosexual men in a high-HIV prevalence region, 93% agreed that men should consider MC for HIV prevention, and 58% would accept free medical MC [70]. Facilitators of acceptability included improved penile hygiene (97%), reduced HIV/STIs (91%), lower risk of penile cancer (90%) and of cervical cancer in their female partner (86%) [70].

In Kenya, perceived improvement in sexual pleasure was a facilitator [69]. In the Dominican Republic willingness was only 29% initially, but after an information session explaining the risks and benefits of the procedure, this figure increased to 67% [64]. Acceptability in Thailand was 14%, rising to 25% after an information session [71]. In a Chinese study, 39% were willing to be circumcised to protect themselves from infection, and 46% would consider it to protect their partner as well [72]. In other samples of mostly heterosexual Chinese men, 41% were willing to be circumcised in one study [73] and 25% in another [74].

Even if a man is willing to be circumcised this does not mean he will end up having the procedure done. On the other hand, a lack of willingness to be circumcised should not be interpreted as a preference to be uncircumcised. This is because a large number of barriers have been documented, such as fear of pain or complications, embarrassment, inconvenience and cost. The obstacles are discussed in the following sections. It is reasonable to suppose that, if these barriers could be addressed through the provision of correct information and financial assistance, the fraction of men willing to be circumcised would increase significantly. Better education of parents before or soon after their baby is born about actual risks should, by helping to ensure a circumcision in infancy, avoid later deliberations and barriers to circumcision in adolescence and adulthood.

2.5 Barriers to circumcision

1) Pain

Since not all men are willing to be circumcised, even when their infection risk from not doing so may be high, there are clearly barriers to an affirmative decision, particularly in high HIV prevalence settings where MC is being rolled-out to reduce infections.

In a review of 13 acceptability studies of heterosexual men in sub-Saharan Africa, concern about possible pain was "the major barrier" to agreeing to be circumcised [63]. As well as pain, the long healing period, abstinence from sex, and MC not being part of the local culture, were other impediments to getting a circumcision [69]. In Pune, India 71% of men expressed this concern [70]. Amongst MSM, fear of pain was a barrier for 62% of men in the USA [75] and was 47% for Chinese men [76]. An acceptability study among African-American parents found that despite high (88%) perception of pain in their child, 73% strongly believed that MC was necessary [67].

In practice, the pain associated with medical MC is far less than men anticipate, and many are not aware that local anesthesia is recommended. In a small trial of the "Shang Ring" device used to circumcise 40 men, pain scores (graded from 0 = no pain to 10 = worst possible pain) averaged 3.5 during erections [77]. Since erections would place the most tension on the wound during healing, erections likely contribute maximally to pain scores.

It is instructive to consider here the issue of pain associated with an infant circumcision. In infancy, local anesthesia is effective in reducing or almost eliminating pain during and after circumcision, although gauging the level of pain experienced is more subjective than what can be ascertained from communications by older children or men. Of interest is that neonates exhibit lower pain scores than older infants [78]. Their response to pain in general is less when delivered vaginally than by cesarean section [79]. We should not forget that, early exposure to noxious or stressful
stimuli decreases pain sensitivity and behavior in adult life [80]. While there may be some short-term memory of pain, no credible study has been conducted into long-term memory of pain experienced in infancy. Irrespective of such considerations we strongly support a recommendation of adequate pain control as being essential during and after a circumcision at any age.

Thus, although pain is overall minor and should not be seen as a major barrier, the fear of pain for later circumcision does represent a significant barrier.

2) Cost

Acceptability studies show cost to be a frequent barrier to adult MC [63], although willingness is higher if costs are borne by others. The cost of a neonatal circumcision is far lower than circumcision later [60]. Cost estimates in the USA for a circumcision are approximate $165 to $257 [81] in infancy, compared with approx. US$1,800-2,000 for circumcision in adolescence or adulthood [82]. Even if the adolescent or adult male wants to be circumcised, the cost can be prohibitive. Cost can be reduced by insisting on a local anesthetic, since a general anesthesiologist's fees can be considerable. In developing countries, the cost of a circumcision is typically US$59 for adults or adolescents, and US$15 for newborns [15]. Thus the cost of adult MC represents a significant sum. Affordability of MC is not helped by the lower earnings typical of younger men. In developing countries, the extreme poverty of many people means any cost is unaffordable by most of the population.

3) Cosmetic outcome

When circumcision is performed in infancy the ability of the inner and outer foreskin layers to adhere to each other means sutures are rarely needed and the scar that results is virtually invisible [60]. Other factors include the more rapid healing at this time of life, contributed by age-associated differences in pro-inflammatory factors that might affect scar formation [83].

In studies on adult MC, both men and their partners preferred the new appearance of the penis post-circumcision [84]. In the case of MSM, in a Chinese study, only 2.5% of men expressed concern about cosmetic outcome [76]. Despite the fact that MC rarely causes permanent disfigurement from scarring when performed properly, the fear of a poor cosmetic outcome is a documented deterrent of acceptability. For example, a study in the South American Andes found that MSM identified the risk of scarring as a significant barrier to MC [85].

4) Sexual function and activity

The effect of an infant circumcision on sexual function and activity cannot be determined directly, but can be inferred from studies of men circumcised as adults. Numerous studies show that MC has no adverse effect on sexual function [84]. This finding is supported by data from the large RCTs in sub-Saharan Africa [86] which included more than 10,000 participants. A study in Turkey found no relationship between age of childhood circumcision and overall sexual function in men aged 22-44 [87]. Since all men are circumcised, mostly in childhood, in this Muslim country there was no control group of uncircumcised men to compare with. Of seven areas of sexual function examined (frequency of intercourse, communication, degree of satisfaction, avoidance, sensuality, ejaculatory function and erectile function), the only difference was lower avoidance in those circumcised between the ages of 0-2, compared to the 3-5 and 6-12 age groups [87]. However, a study of MSM in Sydney reported that later circumcision was associated with erectile dysfunction and premature ejaculation difficulties in some men [88]. Such difficulties were not seen in men who had been circumcised in infancy.

When circumcision is delayed beyond the onset of sexual activity, the impact of a period of abstinence must be considered. Analysis of data from three RCTs found that relatively few men engaged in sexual intercourse within 42 days of circumcision [89]. Reasonable suggestions has it that this period of complete abstinence (from both
intercourse and masturbation) is "often daunting and serves as a disincentive for men to undertake the procedure" [90], and the recommended post-surgical abstinence period was found to be a significant barrier to MC uptake in Kenya [91]. Circumcision in infancy, or indeed at any time before puberty, eliminates such an obstacle.

### 2.6 Psychological consequences

Very few credible studies have examined psychological factors associated with MC.

A study of Californian boys in their early teenage years found that circumcised boys - the majority of whom were circumcised neon tally - were more satisfied with their circumcision status than were uncircumcised boys [92]. A study in Sweden, where MC is uncommon, found no serious psychological disorders amongst boys circumcised in childhood, although shyness in the change-room was noted in 7% [93]. An acceptability study conducted in the Sichuan province of China found 53% of men were concerned that MC would be "too sensitive and embarrassing" [73]. Concerns were also expressed that men might be mocked for undertaking the surgery. In India, where MC is a mark of religious affiliation, 41% of mostly Hindu men were concerned that MC was not part of their culture, while 30% were afraid of stigma or rejection [70].

There is some concern about risk-compensation (the tendency to stop using condoms and increase the number of sexual partners) following MC, although in most studies in which men were counseled this was not seen [94]. It has been suggested that neonatal MC may reduce the chances of a change in behavior due to circumcision status, as the male will not perceive any change in risk compared to what might transpire if the circumcision had taken place at an age when he might be sexually active [95].

While these various psychological problems should be mitigated by making MC normative in a community, just as with most fears and anxieties, the prospect of such concerns would be largely eliminated if MC were performed in infancy.

### 3. CONCLUSIONS

This review has attempted to provide reasons why infant circumcision is the best. Circumcision during this period has a lot of benefits which includes: substantially lower costs, lower risk of complications when performed by an experienced doctor in a clinical or other appropriate settings, and lower lifetime risk of a variety of adverse conditions and infections [186]. The health benefits include protection against urinary tract infection and thus permanent damage to the young kidney, reduced likelihood of penile inflammation, and elimination of risk of phimosis, which impedes micturition leading to difficult and painful erections in adolescence and adulthood. Infant circumcision assures greatly reduced risk of penile cancer later in life, no smegma, better hygiene, and lower risk of various STIs both to the males themselves and to their female sexual partners in future. The barriers to MC in infancy is fewer. The infant is less mobile, thereby facilitating the use of local anesthesia, the procedure is simpler, healing is quicker, better cosmetic outcome, with high cost-effectiveness and acceptability.

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