"EFFICACY OF PRE-OPERATIVE HAIR REMOVAL ON THE DAY BEFORE SURGERY BY ROUTINE RAZOR SHAVING VERSUS DEPILATORY CREAM IN PREVENTION OF POST SURGICAL SITE INFECTION IN PATIENTS ADMITTED WITH INGUINAL HERNIAS"- A COMPARATIVE STUDY AT KLES DR. PRABHAKAR KORE HOSPITAL AND MRC, BELGAUM.

By

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Dissertation

Submitted to the KLE UNIVERSITY

Belgaum, Karnataka

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY (M.S.)
IN
GENERAL SURGERY

Under the guidance of

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MAY – 2011

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ACKNOWLEDGEMENT

I take this opportunity to express my respect and heart felt gratitude to all my teachers.

I gladly utilize this opportunity to express my deep sense of gratitude and indebtedness to my respected teacher and guide **Dr. P. S. PATTANSHETTI** M.S. Professor, Department of Surgery without whose everlasting inspiration, incessant encouragement and criticism, with valuable suggestions for improvement, the completion of this study would not have been possible.

I am extremely grateful and indebted to **Dr. S. M. UPPIN** M.S.; FICS Professor and Head of the Department of surgery, J. N. Medical College, Belgaum, for his valuable advice and guidance in completing this dissertation.

I also wish to express my deepest gratitude to **Dr. V. D. Patil** M.D.;D.C.H. Principal, J. N. Medical College, Belgaum, for allowing me to conduct this study.

I express my sincere gratitude to **Dr. V. B. Dhaded** M.S.;FICS.,**Dr. A. S. Godhi** M.S.; FICS, **Dr. M. S. Sangoli** M.S., **Dr. V. M. Uppin** M.S., **Dr. S. S. Shimikore** M.S., **Dr. I. V. Uppin** M.S., **Dr. A. S. Gogate** M.S.,**Dr. B. V. Gogeri** M.S., FRCS (Late), **Dr. S. C. Metgud** M.S and **Dr. A. C. Pangi** M.S.,Professors who have encouraged me during the course of study. I thank them for their inspiration and moral support.

I thank **Dr. R. R. Rao** M.S, **Dr.BasavarajKajagar** M.S., Associate Professors, Department of Surgery, for their valuable guidance throughout the course of this study.

I express my sincere gratitude to **Dr. R. S. Koujalagi** M.S, **Dr.Santosh B. Patil** M.S, **Dr. V. M. Pattanshetti** M.S, **Dr. S. N. Halabhavi** M.S, **Dr. Manoj Togale** M.S, **Dr Rahul K** M.S, **Dr Aman. Mahajan** M.S, **Dr Parag. Hawaldar** M.S, **Dr Pushpa K** **M.S** Assistant Professors, Department of Surgery, who have provided me with moral support during the study.

I would like to extend a vote of thanks & appreciation to **Dr Prashant Hombal** M.S., **Dr Prashant Babanavar** M.S., Senior Residents, Department of Surgery.

I whole heartedly thank **Dr Manoj Kumar Bhutte** M.S., **Dr Prakash Mahantshetti** M.S. for their immense help.

From the bottom of my heart I convey my heartfelt gratitude to **All Patients** without whose co-operation this study would have been incomplete.

No amounts of words can measure up my deep sense of gratitude and fullness that I feel towards my parents **Shri. D. R. Jalde** and **Smt. K. D. Jalde** and other family members and friends.

I express my sincere thanks to my friends **Dr. Santosh Chikraddi, Dr.Shailesh, Dr.Gurupadappa, Dr .Satyajit, Dr.Umashankar, Dr Sunil Reddy, Dr Amit K, Dr Biju, Dr Santoshi, Dr Siddharth, & Dr Abhay** for their constant help, support, encouragement and cooperation in designing my dissertation.

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LIST OF ABBREVIATIONS USED

CDC- Centres for disease control and prevention

SSI- Surgical site infection

RS- Razor shaving

DC- Depilatory cream

ABSTRACT

Background and objectives:

Surgical wound infections are a major source of post-operative illness, accounting for approximately a quarter of all nosocomial infections resulting in longer hospitalization and higher cost of care. Previous studies taken up in the institution favouring use of intra incisional antibiotic instillation before closure of wounds suggested wound contamination as the cause of high wound infection rates. It was thought that a review of skin preparation protocol could bring about reduction in the wound contamination from the skin.Review of literature showed the changing trends in skin preparation. So evaluation of alternate methods of depilation was planned. Depilatory cream was chosen as the alternative method due to easy availability and apparent lesser cost compared to other alternative methods like clippers.

The objective of this study was to compare the efficacy, safety and cost of hair removal before surgery by safety razor (RS) versus a depilatory cream (DC), and to recognize the best technique of pre-operative hair removal and study the patients preference, operating surgeons preference and personnel (nursing staff) response to the two methods.

Methodology:

The present study was conducted in the Department of Surgery K.L.E.S Dr. Prabhakar Kore Hospital and Medical Research Centre , Belgaum on 60 patients with inguinal hernias between March 2009 to February 2010. The patients were randomized in two groups of 30 each and they were subjected to different techniques of hair removal i.e., by razor shaving vs depilation using a depilatory cream and incidence of post-operative SSI was noted. The outcomes were categorised, tabulated and analysis was done. Also the patients and the operating surgeons satisfaction level, time and cost between two groups was evaluated.

Results:

There were 30 patients each in RS group and DC group. 7 patients in RS group had post-operative SSI while only one patient in DC group had post-operative SSI. Therefore post SSI was higher in RS group. Patients and surgeons satisfaction score is higher in DC group.Time required forshaving was 15.6 min while depilation took 25.1 min. Time required for hair removal is significantly higher in depilation group compared to razor shaving. Cost of hair removal in RS group was Rs 10 while the same in DC group was Rs 30. So hair removal by razor shaving was cheaper than that by depilation.

Conclusion:

Pre-operative hair removal by depilatory cream is superior to razor shaving in terms of safety, satisfaction and efficiency of prevention of SSI. The cost and time needed for procedure though apparently higher compared to razor shaving, is not prohibitive for implementation. It can be safely followed with prior administration of ‘skin test’

and patients can be depilated any time before surgery without increased risk of wound infection.

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INTRODUCTION

Surgical wound infections are a major source of post-operative illness, accounting for approximately a quarter of all nosocomial infections resulting in longer hospitalization and higher cost of care[1, 2].

It was in 1992, the centers for disease control and prevention (CDC) changed the terminology for infections associated with surgical procedures from surgical wound infection to surgical site infection (SSI). These infections are classified into incisional SSI, organ or other organs and spaces SSI when manipulated during an operation. Incisional infections are further divided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue-muscle and fascia) [3].

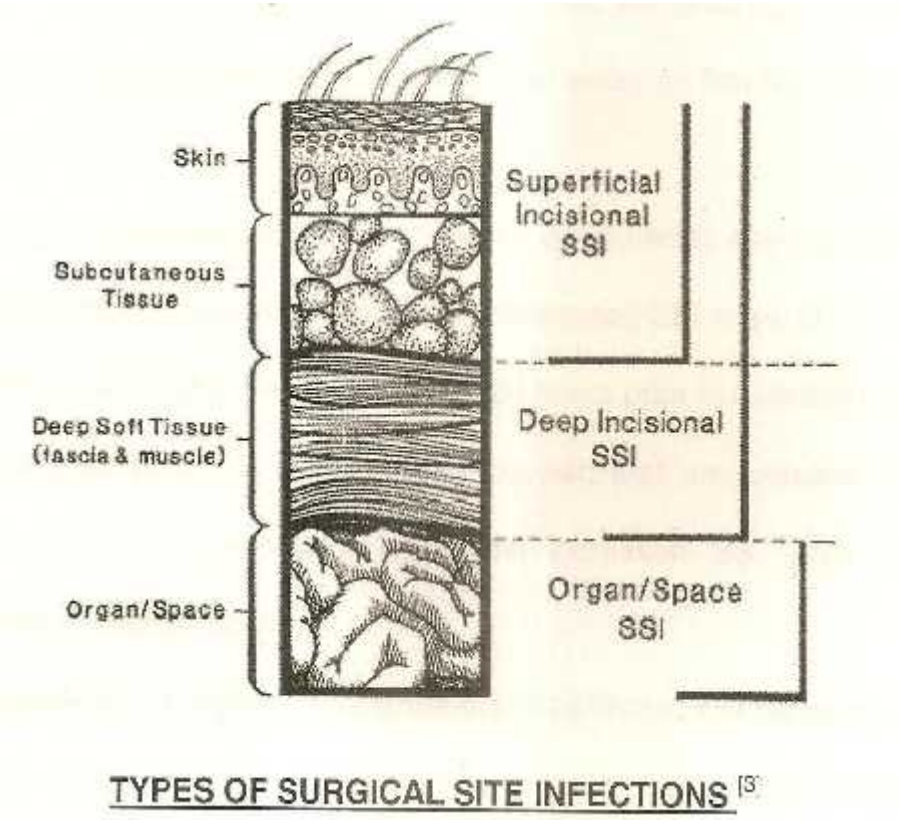


Figure 1

Preventing post-operative surgical site infections (SSI's) through pre-operative skin preparation has a long history. One measure for preventing SSI's has been to remove patient's hair in the surgical field using a safety razor. In the 1970s and 1980s, clinical investigations indicated that shaving increased the frequency of SSI's and that depilation or electric clippers were preferable if hair removal was necessary[4]. However concepts of different techniques for pre-operative hair removal have been changing over the years. In the absence of reliable evidence, they have been mostly guided by the surgeon's experience and knowledge.

In the year 1999 centers for disease control and prevention (CDC) gave its guidelines for prevention of post-operative SSI's after a thorough literature search. Pre-operative shaving of the surgical site is associated with a significantly higher SSI risk than either the use of depilatory agents or no hair removal[4-12]. The increased SSI risk associated with shaving has been attributed to microscopic cuts in the skin that later serve as foci for bacterial multiplication[10]. Shaving immediately before the operation compared to shaving within 24 hours pre-operatively was associated with decreased SSI rates (3.1% vs 7.1%); if shaving was performed greater than 24 hours prior to the surgery, the SSI rate exceeds 20%[13] .Other studies showed that pre-operative hair removal by any means was associated with increased SSI rates and suggested that no hair be removed pre-operatively[12].

The guideline strongly recommends that hair should not be removed pre-operatively unless the hair at or around the incision site will interfere with the surgical procedure. If hair is removed, however, it should be done immediately before the surgery, preferably with clippers[13].

The Norwegian center for health technology assessment, Oslo, reviewed the evidence on the necessity of several pre-operative and peri-operative hygienic

procedures. They questioned the reliability of the literature search and the subsequent clinical literature appraisal, based on which CDC had formulated its guidelines were also not described.

So before implementing the recommendations, staff members at the Norwegian center for health technology assessment did a systemic search of relevant scientific literature to compare the center's and the CDC's conclusions. Team members chose to first assess pre-operative hair removal and the subsequent incidence of SSI's[14].

In this assessment, strong evidence was also found to advocate that hair should not be removed pre-operatively. Several studies did not demonstrate clear difference between shaving and no hair removal, despite shaving in several studies being associated with increased SSIs when compared to others methods of hair removal. The other recommendation made by the CDC is that if hair is removed, depilation should be used immediately before the surgical procedure. The conclusion partly covers this statement, and the data to give reasons dissuade from shaving the day before the procedure[12].

If hair is to be removed, depilation is better than shaving. Data also provides moderate evidence to recommend that if hair removal is considered necessary, it should be performed as close to the procedure time as possible.

Hence this assessment of pre-operative hair removal has brought out somewhat different conclusions from those given by the CDC[15].

- It is not strongly recommended that hair removal results in a higher frequency of SSIs than no hair removal.
- Wet and dry shaving the evening before the procedure results in a significantly higher infection rate than depilation.

- There is no convincing difference in the incidence of postoperative SSIs between depilation and hair removal.
- Hair removal with depilation should be performed as close as possible to the time of surgery.

Despite a growing body of research proving that shaving is unnecessary and perhaps even detrimental, more than half of the surgeons are still using razors for pre-operative hair removal. According to a recently conducted survey, only 27% of respondents stated their surgeons used depilation for hair removal [16].

In our set up, pre-operative hair removal is being done using razor shavings on the evening / night before surgery followed by bath on the day of surgery. Though exact statistics of wound infection in our set up is not available, an overall wound infection of 20 – 25 % has been estimated. These figures are high when compared to that quoted in literature (4.7 to 17%: Cruse and Foord, 1980)[5].

This study has been undertaken to evaluate pre-operative hair removal by razor shaving versus depilatory cream with regard to post-operative wound infection, patient and operating surgeons acceptance, efficacy, safety, time required for hair removal and cost of hair removal.

OBJECTIVES

The objectives of the study are:

1. To compare the efficacy, safety, time needed for preparation and cost of hair removal before surgery by safety razor and a depilatory cream.
2. To recognize the best technique of pre-operative hair removal.
3. To study the patients preference, operating surgeons preference and personnel (nursing staff) response to the two methods.

REVIEW OF LITERATURE

Definitions -

Hair removal is described as any method of removing hair, especially from the human body. It could be permanent or temporary depending upon the mechanism of the hair removal.

Depilation: Defined as removal of part of the hair above the surface of the skin, leaving behind an intact hair follicle which helps in subsequent regrowth of hair. The most common form of depilation is shaving. Other popular options are clipping and chemical depilatories.

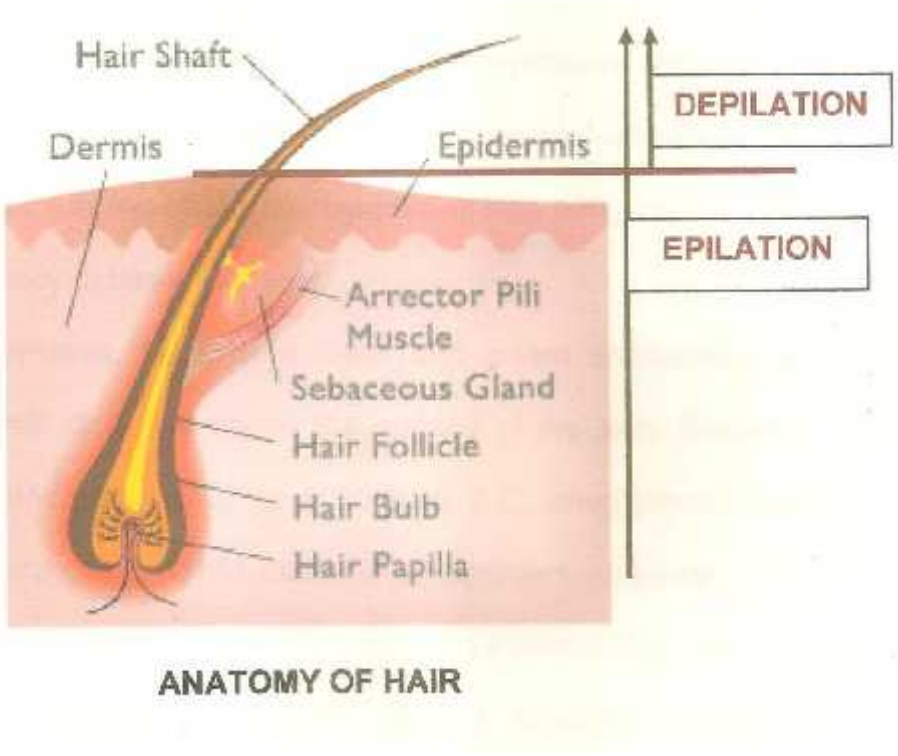


Figure 2

Epilation: Defined as removal of entire hair, including the root with or without destruction of hair follicle. Destruction of hair follicle makes it a permanent method of hair removal. Some of the commonly used epilation techniques are waxing, sugaring, epilation devices, lasers, threading, intense pulsed light or electrolysis.

Historical aspects -

Hair removal has been practiced for centuries in almost all human cultures. The methods used vary among time and regions. The pursuit of a hair free body may be as old as cavemen. Archeologists have evidence that men shaved their faces as far back as twenty thousand years ago, using sharpened rocks and shells to scrape off hairs.

The Sumerians removed hair with tweezers. Ancient Arabians used string. Egyptians including Cleopatra also did it – some with bronze razors, some with sugars and others with beeswax. Roman men shaved their faces until Emperor Hadrian. Julius Caesar is said to have his facial hairs plucked. Roman ladies also plucked their eyes brow with tweezers. Another primitive method of hair removal, actually used by women as late as 1940's involved rubbing off the hair, by rubbing skin with abrasive mitts or discs the consistency of fine sandpaper.

As an alternative, there were lotions and cream depilatories that dissolved – and still do – hair above the surface of the skin. Evidence of depilatory cream dates as far back as 4000-3000 B.C, when women used a depilatory "rhusuma turcorum" containing orpiment (natural arsenic trisulphide), quicklime (used to make cement) and starch made

into a paste. There were many alternative methods of hair removal, ranging from pulverized egg shells to a mixture of cat's dung and vinegar [18].

Modern hair removal can be traced back to 1762, when a French barber named Jean Jacques Perret invented the first safety razor when he attached a metal guard to his razor blade to prevent the blade from cutting the skin. Almost a century later (1895) came a travelling salesman inventor named King Gillette with his idea of disposable razor blades [18, 19].

Methods of hair removal -

Several options of hair removal exist in the present era. They can be permanent or temporary. In temporary hair removal, hair is removed from the surface of the skin or from the root without destroying the hair follicle.

Permanent:

A. Laser hair removal: A procedure in which a laser beam is used to disable hair follicles. It permanently removes all hair and also reduces the amount of visible hair. One treatment can eliminate 30 to 40 % of hair for up to a period of one year (the rest may grow back, but with a finer texture).

B. Electrolysis: It involves inserting a fine needle into the hair follicle and electronically charging the root of the hair to kill it, however, a new root cell can form in the same area, causing regrowth. Compared to other hair removal methods, it is relatively new, time consuming and expensive.

Temporary:

A. <u>Depilation</u>: Lasting several hours to several days.

I. **Shaving**: This method uses a sharp blade, held within the head of a razor, which is drawn over the patient's skin to cut hair close to the surface of the skin. This method is quick and cheap; however the hair grows back rapidly which is very coarse.

II. **Clipping:** Clippers use fine teeth to cut hair close to patient's skin, leaving short stubble of usually around one millimeter in length. The heads of the clippers can be disposed of or disinfected between patients to minimize the risks of cross infections.

III. **Depilatory creams:** Chemical depilatories contain keratinolytic agents and work by breaking the disulfide bonds that link the protein chains that give hair its strength, making the hair disintegrate. There is a risk of irritant or allergic reactions to the cream and patch tests should be carried out 24 hours before the cream is applied.

IV. **Friction:** Rough surfaces used to buff away hair

B. <u>Epilation</u>: Lasting several days to several weeks

I. **Tweezing:** After the development of tweezers, there was little advancement in "mechanical" hair removal until the invention of electronic tweezing in the late 1950s. Although electronic tweezing employs an electronic current during the

tweezing process, the results are no more effective than regular tweezing and can be costly.

II. **Waxing:** Waxing uproots the hairs from its follicles for the longest lasting (up to eight weeks), smoothest results of all temporary hair removal methods. There are two kinds of wax more commonly used today, warm and cold. Both methods remove hair at its root below the skin's surface. Warm wax or hot wax was developed in the 1980s in Australia. Actually, it is a sugar mixture, heated, applied to the skin and then removed with muslin or cotton strips which absorb the wax, allowing it to grip to hair. Cold wax, in either paste or gel form, is applied to the skin without heating. However, most cold waxes are messy to apply (delivery from the container to the skin is difficult) and thickness of application cannot be controlled. During the 1980s, Marzena introduced natural wax into the wax strip system and refined the process, making it the quickest and most efficient method of hair removal in the market today.

III. **Sugaring :** Body sugaring is a hair removal process first used by Middle Easterners, involving the application of a natural, sugar based paste (usually sugar, lemon and other natural ingredients cooked to the consistency of soft taffy) that was either rubbed or pulled off in the opposite direction of hair growth.

IV. **Threading** (also called fatlah or khite): In which a twisted thread catches hairs as it is rolled across the skin.

V. **Epilators:** Devices that rapidly grasp hairs and pull them out by the root[20, 21, 22].

This obsession with hairlessness probably had as much to do with hygiene as with ideals of beauty and fashion. The hot Middle Eastern climate encouraged germs and diseases to breed, and the removal of all body hair was a preventive measure against infection.

In Ancient Egypt, many people depilated their entire bodies to prevent infestation by lice, fleas, and other parasites. Shaving of hair has sometimes been used in attempts to eradicate lice or to minimize body odor due to accumulation of odor causing micro-organisms in hair [18].

Factors that influence infection rates –

Altemeier has stated that risk of wound infection varied according to the equation[23].

$$\frac{\text{Dose of Bacterial Contamination X Bacterial Virulence}}{\text{Resistant of Host}}$$

Of these, two of the factors – bacterial contamination and host resistance – are the ones that appear to be under our control. Most factors like skin, both of the patients and the doctor, theatre environment, instruments and surgical technique finally influence wound infection by wound contamination (Cruse and Foord)[5].

The importance of degree of contamination has been best demonstrated by Elek and Conen in 1957, when they showed six million Staphylococcal had to be injected

intradermally to produce a pustule in a medical student. They found that the number of bacteria needed to establish infection can be reduced by 10,000 fold by mere presence of silk suture[24]. Howe and Marston showed that the effective dose could be even further reduced if the silk suture contained tissue[25].

All wounds are essentially contaminated; the key of the infection is the extent of contamination, presence of foreign material (Suture, mesh) and devitalized tissue, contamination to a large extent is preventable. Hence, every effort should be made to keep contamination to the minimum.

Wound contamination can occur from a host of exogenous or endogenous sources. Increasing source of infection with increasing contamination has been shown in Cruse and Foord's study[5]. This point to the overriding influence of endogenous contamination in causation of wound infection.

The source of endogenous contamination is often traced to the skin and its appendages especially so in the clean wounds. Hence it is prudent to study this large organ with its appendages that are commonly flooded with organisms and so predisposes to wound contamination and wound infection and to institute effective measures to contain wound contamination.

Skin and microflora -

The skin is an anatomically and physiologically specialized boundary lamina essential to life. It accounts for about 8% of total body mass. It covers the entire external

surface of the body and continues with the mucous membranes at body orifices through specialized mucocutaneous junctions. Major part of the body is covered by thin hairy skin while thick hairless skin (Glabrous) covers areas of increased friction like palms and soles.

Structurally, the skin is complex and highly specialized. It forms a major interface between the body and environment. It is composed of two areas – the superficial keratinised epidermis and the deeper connective dermis.

The dermis is made up of irregular, moderately dense soft connective tissue. Its matrix consists of interwoven collagen meshwork with varying quality of elastic fibers, polyproteoglycans, fibronectins. The blood vessel, lymphatics, nerves and nonstriated erector pilorum muscles also form components of this layer. It is divided into two layers- the superficial pappilary dermis which is immediately next to the epidermis and covers its appendages and the deeper reticular dermis. This layer provides mechanical strength and elastic recoil in addition to nutrition and defense cells vital to the survival of the epidermal layers. This layer is also the physiologically active part of the skin.

The epidermis is composed of keratinized stratified squamous epithelium. In this tissue, there is continuous shift of the cells from the mitotic basal layer to the surface where they are shed. The progressive changes in the shape and content of the basal cells give rise to the identifiable zones of epidermis – stratum basale, stratum spinosum, stratum granulosum, stratum lucidum and stratum corneum – from deep to superficial. The first three layers are metabolically active and are often grouped as the germinative

zone while the superficial two layers have achieved terminal kertinisation and are together termed as cornified zone.

The cells that differentiate in this pattern are called keratinocytes and form the bulk of cells in epidermis. Other specialized cells found in the epidermis include the pigment producing melanocytes, the phagocytic Langerhans cells and the neutrally associated Merkel's cells[26].

In addition to the different layers of the epidermis, various structures - the epidermal appendages or adnexa – are formed by epidermal ingrowth or other modifications and thus are communicating to the exterior. These include the glands – sebaceous, sudorific (sweat), hairs and hair follicles, and nails. Each extends into the underlying tissue to varying depths. The functions of these appendages are ill defined in the humans.

The above attributes make the skin, within limitations, an effective barrier against microbial invasion, dehydration and mechanical, chemical, osmotic, thermal and photic damage. In addition, it also plays an active role in the body's thermal regulation.

It is this last function that the pelage (hair cover) served, at least in part in lower animals. In man, the hairs have become vestigial and serve no vital function; however, its psychological function is well recognized.

The pelage of the body has a wide array of hair types. Prenatally, the body is covered with fine non-medullated hairs called lanugo hairs that disappear by birth. Post-natally, body hairs can broadly be divided into two types: the widely distributed 'vellus hair' that is soft, non-medullated and non-pigmented; the 'terminal hair' that is large,

coarse, pigmented and limited to the scalp upto puberty. At puberty, the villous hairs over the body at certain areas like pubic and axillary regions, legs and forearm are replaced by terminal hairs. In the remaining areas, a host of intermediary types are found, especially so in the males.

Hair grows from follicles which are stocking like infoldings of the superficial epithelium around small studs of dermal pappilae. The cylinders of the hairs may be regarded as a holocrine secretion of cells arising by division of cells surrounding the papilla in the region known as bulb. The external hair is made up of three zones from within outwards- the medulla, cortex and cuticle. It is chemically composed of keratins - group of insoluble cysteine containing proteins produced in the epidermal tissues. The 'keratins' of the hairs have higher content of sulphur than the keratins of the desquamating tissues – squames of skin.

The hair growth is dependent on the activity of the hair follicle. The hair follicle activity in the humans is intermittent. The hair grows to attain a maximum length (anagen phase), remains stationary for a variable period of time (telogen phase) and is eventually shed (catagen phase) before the cycle is repeated all over again. The average rate of hair growth of villous hair is 0.05 mm per 24 hours while that of the terminal hair of the beard is 0.38 mm per 24 hours. The rate of growth is greater in men than women over the whole body. Hair growth may be stimulated by plucking the hair from its root. Shaving has no effects on the rate of growth.

The erector pilorum is attached to the hair follicles at the dermo-epidermal junction. Above its attachment, one or more sebaceous glands open into the follicle and

secretions of these glands make their route to the surface at the follicular openings. These together form a potential nidus for bacterial colonization.

Skin is an exposed surface membrane and so is continuously flooded by micro-organisms from internal and external sources deposited on it. The skin surface provides a rich substrate for the growth of organisms. It contains fat, protein and other nitrogenous substances, carbohydrates, minerals etc which are by products of keratinization or are produced by the cutaneous appendages. A luxuriant micro-flora thrives on this surface milieu and is predominantly bacterial with a few fungal representatives. Prince in 1938 has grouped the surface micro-flora into two categories – transient and resident.

Transient flora: includes a large multiplicity of organisms that do not / cannot maintain themselves indefinitely on the normal skin (as do the resident flora). They are more readily removed from the normal skin by scrubbing and by disinfectants.

Pathogens and non-pathogens make up the transient flora and the list is very long. A complete roll-call of transient organisms would essentially include all the organisms found in the man's environment. The most common ones are gram negative bacilli from the GIT, streptococci and various species of micrococcus. Species of candida and Cryptococci are common fungal transients.

Transient organisms persist appreciably on skin only if there is continuous replenishment from some external / internal source or the skin integrity is disturbed due to disease or injury making wounds (surgical wounds inclusive) a preferred site where they may reach pathogenic proportions.

Resident flora: are organisms that are found more or less regularly in appreciable numbers on the skin of most normal individuals. These organisms form stable communities on the skin surface and are not easily dislodged. This population is able to maintain itself against the constant pressure of competitive organisms (transient flora) which are continuously contaminating the skin surface.

The number of species comprising the resident flora is surprisingly small. Members are micrococci, corynebacterium, pityrosporon and propiobacterium acnes.

Cocci are found on all individual with variation in age group and populations with S. epidermidis and S. homonis being the commonest species isolated. The potentially pathogenic S.aureus is found in smaller numbers with 8 – 20 % of samples of various parts of the body showing its presence. It may be seen in as many as 40% samples from the hand. Skin carriage is usually associated with nasal carriage of identical serological and phage types. S.aureus appears to be a part of resident microflora of the perineum. The anaerobic microbes outnumber the aerobic in ratios between 10 : 1 and 100 : 1 and flourishes most in sebaceous glands where anaerobic conditions prevails[26, 27].

Anatomic distribution of microbata in skin -

Although there are large numbers of organisms on the skin surface, simple smears and scrapings do not reveal them. The resident organisms do not occur in or between lining cells of the epidermis and its appendages: they are outside the viable portion of the skin. The stratum corneum is not the principle site of colonization; since this layer, when peeled away in successive films, is rarely found to contain any bacteria demonstrable by

staining. Similarly, the resident organisms do not colonize the sweat ducts. However, they are found in abundant numbers at the follicular orifices.

Hair is of special interest as it harbors S. aureus and forms a reservoir for cross infection.

Quantitative assays of the counts have shown a direct relation between the number of sebaceous glands and hairs and increased counts. The organisms are not in the sebaceous glands themselves as stated by some, but in the upper portion of the follicles into which the sebum empties. For the most part therefore, the organisms form colonies within the holes of the skin and it is difficult to dislodge them from their protected fox holes by mechanical and chemical means[27].

Factors influencing cutaneous flora and its distribution -

Sex has no influence on the composition or quantity of organisms on glabrous skin.

As already stated, higher counts are encountered at areas with greater number of sebaceous glands and hair follicles. Thus, the counts are lowest over the trunk and highest at intertriginous areas like axilla, groin and areas of marked sebaceous development like faces, scalp and upper chest.

Oily skin have higher count, it appears that the skin lipids promote growth of certain bacteria. Metabolites of sebum and free fatty acids thus produced also support growth.

Moisture unquestionably promotes bacterial growth. This has best been demonstrated by hand washes with soap and water for 15 minutes. When thus washed and left exposed to air, the flora does not regains the original counts for about a week; but, this period is reduced to a few hours if rubber gloves are worn at the end of scrubbing. This accelerated restoration of normal flora has been attributed primarily to moisture. Such profound transient increase in the bacterial counts occurs in individuals who sweat profusely. Decreased hydration of the skin's surface probably accounts for slightly lower bacterial counts during winter months.

The resident microflora also depends on interaction between different species of organisms.

Though lack of bathing for short durations has shown to cause temporary increase in bacterial counts, especially at the moist areas. Bathing has little effect on resident's skin flora.

Pillsbury D.M and Kligman A.M have aptly summarized – skin is never sterile and cannot be rendered so by any practical means[28].

Preoperative hair removal -

In UK nearly 10% of the patients undergoing surgery develop post-operative SSI each year which results in delayed wound healing increased hospital stay, unnecessary pain and in extreme cases death of the patient [30, 31].

Preventing post-operative surgical site infections (SSIs) through pre-operative skin preparation has a long history. The pre-operative preparation of patients for surgery has traditionally included the routine removal of body hair from the intended surgical wound site. Presence of hair in the surgical field can interfere with the exposure of the incision and subsequent wound, the suturing of the incision and the application of the adhesive drapes and wound dressings[29-32]. Hair is also perceived to be associated with a lack of cleanliness and the removal of hair is thought to reduce the risk of surgical site infections (SSIs)[24].However, there are studies which claim that pre-operative hair removal is deleterious, perhaps by causing SSIs, and should not be carried out[2, 6, 7, 10, 11, 25-28].

The requirement of hair removal in the pre-operative setting is temporary. Hence of all the available methods of hair removal; shaving, clipping and chemical depilation are the preferred modalities[33-35].

Shaving is the commonest method of hair removal. During the process of shaving, the skin may experience microscopic cuts and abrasions[13]. It is believed that microorganisms can enter and colonize these cuts and contaminate the surgical wound causing post-operative wound infections. In addition abrasions may ooze exudates, which may provide a culture medium for microorganisms[4]. The source pathogens for most nosocomial infections are skin dwelling microorganisms[36].

Hair removal using depilatory cream is a slow process than shaving as the cream has to remain in contact with the hair for 5 to 20 minutes. In addition there is a risk

of irritant or allergic reactions to the cream [11, 13, 38]. A patch test should be carried out 24 hours before the cream is applied.

Shaving can be carried out in operating theatres, anesthetics rooms, and wards or in people's homes by theatre staff, ward staff, or by the patient themselves, whereas chemical depilation is usually carried out in wards or at home as it requires more time. Research has suggested however that hair removal should not take place in the operating theatre as loose hair may contaminate the sterile surgical field[36].

Chemical depilatory creams are now widely available at local pharmaceuticals across the counter. Sulphides and stannites, used in the past, have now been replaced by substituted mercaptans. The substituted mercaptans form the basis of virtually all modern depilatory preparations. These are slower in action compared to the sulphides, but, safer even to be applied over the face.

Thioglycollates are the commonest agents used in a concentration of 2-4 %. Typically, they act in 5 – 15 minutes. The calcium salts are the most favored as they are the least irritant. These agents act by dissolving the keratin. They are not hair keratin specific and so if left in contact for durations longer than recommended; they can cause skin irritation due to dissolution of epidermal keratin[4].

Seropian and Reynolds have listed the attributes of medically accepted chemical depilatory agent as:

1. Prolonged stability
2. Low allergenecity

3. Effective hair removal
4. Lack of systemic and local toxicity
5. Lack of danger from unintentional prolonged contact
6. Lack of deleterious effects when applied over inflamed / raw areas[4].

They found that a cream containing calcium thioglycollate, calcium hydroxide and strontium hydroxide in a special emollient base met these requirements, and used it in their study of 406 cases in which they compared razor shaving and depilatory cream[4]. They found wound infection in razor group to be 10 times more than that in the cream group. Seropian also noted that the wound infection rate went up with increasing time interval between preparation and surgery. In other words the longer the time between preparation and surgery the higher the infection rate. Seropian and Reynolds have used the cream over tender, swollen, injured inflamed areas without any side effects. Of the 157 patients prepared using cream, only 2 patients developed irritation following cream application. He encountered infection rates of 5.6% for razor prepared patients and 0.06% for cream prepared patients in, which was similar to that found in patients in whom no preparation was done[4].

Cruse and Foord have also tried cream preparation but, they found that their population of study (Canadians) seemed strangely resistant to the cream preparation[5].

Hamilton et al using scanning electronic microscope examined skin prepared by safety razor, electric clipper and chemical depilatory creams. They have shown that razor preparation produced gross cuts on the skin surface; clippers tended to nip the skin

especially at flexural areas bur depilatory creams caused no detectable injury / loss of skin integrity[11].

Powis et al (1976) studied 96 cases comparing routine razor preparation to depilatory cream after confirming that the cream was non-irritant and did not support bacterial growth. They included study of post-preparation pre-operative bacteriology and wound infection. They found that, the cream produced significant reduction in colony counts when compared to those patients who were shaved. But, they found no significant reduction in infection rates as found by Seropian. They opine that cream preparation, although theoretically reduces the risk of infection, is preferable over razor preparation as it affords early preparation without significant increase in infection rates[39].

Thur de Koos and Mc Comas (1983) prospectively compared razor shaving and depilatory creams. In their study, the patients were prepared with cream on the previous night. While, the patients receiving shaving were prepared 30 minutes before the proposed procedure in the operating room area. In this setting they found no significant difference in infection rates between the two groups. The effect of preparation – surgery interval has thus been neutralized in this study and probably has confounded the results. However they have outlined the following advantages of cream preparation over conventional shaving:

a) Facilitates hair removal on the day before surgery with no increase in infection rates, thereby saving lot of operating time.

b) It is preferable in areas of uneven surface like upper abdomen, groin and legs.

c) Preferred in patients who have to undergo staged procedures / interventional investigations prior to definitive procedure[40].

Jaffery B. et al studied bacterial colonization following chemical depilation using separate prepared 'test slide' on the upper lateral thigh with a similar corresponding area on the opposite thigh prepared with normal saline. They claimed to have chosen a separate test area to eliminate the effects of variables at the operative wound and the presence of antibiotics. Three areas were marked out in each 'site' and cultures were taken from the corresponding areas immediately, 24 hours, 48 hours after preparation to assess the bacterial growth[26]. They found that cream did not permit growth of resident flora. Fairclough (1987) using a similar method has demonstrated an increase in skin microflora following shaving especially with increase in time[12].

Cruse and Foord (1980), Alexander (1983), Sellick (1991), Ko (1992) have all studied razor shaving versus clipper preparation. All have found clipper (alternative method) to be better than razor shaving[5, 6, 7, 8].

De Geest et al in 1996 undertook a descriptive pilot study of three pre-operative skin prepation protocols, comparing their clinical outcomes and cost implications in patients undergoing heart surgery. The cost evaluation included material costs and labor cost which varied on the type of nurse and time of preparation[41].

They found that clipper protocol in combination with depilatory cream was the most effective method of preparation for patients with heavy hair growth index while depilatory cream was the most appropriate for patients with slight to moderate hair growth. They have condemned razor preparation and suggested it to be eliminated in

view of high infection rates associated with it. It is also interesting to note that the cost calculations suggested only a moderate initial rise in the costs with substantial cost saving in the long run for the clipper and cream protocols[43-45].

Powis has inferred in his study that cream protocol is cheaper than shaving, taking into account the time of staff and disposable equipment used[39].

A systemic review of pre-operative hair removal was published in 2002[14]. The search for this review was up until 1999 and included both randomized and observational studies. Evidence for not removing hair was found in observational studies only. Strong evidence was found in support of depilation in preference to the shaving. Moderate evidence, based on observational studies and a randomized study (though this is not statistically significant) finds that the timing of hair removal should be as close to surgery as possible. The recommendations of the Norwegian Centre for Health Technology Assessment [14] are based on the findings of this review.

Different hair removal practices are recommended throughout the world. For example the Centers for Disease Control (CDC) strongly recommends that hair should not be removed pre-operatively unless the hair at or around the incision site will interfere with the operation. This recommendation differs from the Norwegian Centre for Health Technology Assessment[14] which states that 'contrary to the recommendations given by CDC, it is not strongly recommended to avoid pre-operative hair removal'. The Norwegian Centre for Health Technology Assessment finds that strong evidence does not exist either in favor of, or against, pre-operative hair removal. The British Hospital Infection Society Working Party guidelines[47] recommends that 'only the area to be

incised needs to be shaved' and that shaving should be avoided if possible. If removal of hair is necessary, for example if the surgical site is located in an area covered by thick, dense or long body hair, these three organizations recommend slightly different methods of hair removal.

The CDC guidelines recommend that hair is removed immediately before surgery and preferably with clippers[13], the Norwegian Centre for Health Technology Assessment guidelines recommend using clippers or creams as close to the surgery as possible [37] and the British Hospital Infection Society Working Party guidelines recommend using cream the day before surgery[47].

The recently published Cochrane review has assessed the relative benefits and harms of hair removal, the different methods of hair removal, and the effect of timing.

Preoperative hair removal Vs no hair removal:

A. **Clipping Vs no hair removal** – No studies

B. **Shaving Vs no hair removal** – Two trials involving 358 people compared shaving with no hair removal [32, 48]. Both trials were conducted in the abdominal surgery and used observations and swabs to determine infection. Neither trial reported details of the methods of randomization, allocation concealment or blinding. 9.6% (17/177) of people who were shaved developed an SSI compared with 6 % (11/181) who were not shaved (pooling these two trails using a random effects model gave an RR 1.59). There is no statistically significant difference between shaving and no hair removal, however the trials are not of high quality, and the comparison is underpowered[47].

C. **Depilatory cream Vs no hair removal-** One trial compared cream with no hair removal[32]. The trail was carried out in abdomen surgery and did not provide details of method of randomization, allocation concealment or blinding. 7.9% (10/126) of people who had their hair removed using depilatory cream acquired an SSI compared with 7.8% (11/141) people who had no hair removal; there was no statistical difference between the 2 groups (RR 1.02)[47].

Techniques of hair removal:

A. **Clipping Vs depilatory cream-** No studies

B. **Shaving Vs clipping**- Three trials were considered where people were shaved or clipped prior to the surgery[6, 8, 49], the type of surgery was predominantly clean, such as hernia repair and cardiac surgery. No trails reported full details of randomization, allocation and blinding. Balthazar gave some details regarding the randomization, Alexander used sealed envelopes and Ko stated that the assessors were blinded to the group allocation status. 2.8% (46/1627) of people who were shaved prior to the surgery developed an SSI compared with 1.4% (21/1566) of people who were clipped prior to the surgery[6, 8]. The trials involved similar types of surgery and were pooled using a fixed effects model giving an RR of 2.02. This difference was statistically significant and shows that people are more likely to develop an SSI when they are shaved than when they are clipped prior to the surgery.

C. **Shaving Vs depilatory cream**- Seven trials including 1213 people were considered. Most trials included [4, 25, 50-52] a mix of surgical procedures within one

trial. There were variations with respect to the timing of outcome assessment, three trials did not report at what point the outcome assessment was made, two assessed at day 2 and day 5, one on day 10, and in one trail daily whilst in the ward and at day 28. The data used in this analysis is that of the latest reported wound assessment. The trials were of variable quality, whilst two trials undertook blinded outcome assessment one trial reported that outcome assessors were not blinded the remaining trials did not report clearly. Overall 10% (65/670) of people who were shaved acquired an SSI compared with 7% (38/543) of people who had hair removed with a depilatory cream. The trials were pooled using a fixed effects model and gave a RR 1.54 which shows that people are likely to develop an SSI when they are shaved rather than having hair removed using a depilatory cream.

Timing of hair removal:

Shaving on the day of surgery Vs shaving on day preoperatively: One[6] study compared shaving on the day of surgery with shaving one day pre-operatively in 537 people undergoing elective clean surgery. SSIs were measured on day 15 and day 30. Fifteen day post-operatively 5.1 % (14/271) of the people shaved the day before surgery developed an SSI compared with 6.5% (17/266) who were shaved on the day of surgery. The relative risk 0.81 showed no statistically significant difference between the groups with respect to risk of developing SSI. At 30 days post-operatively, 8.8% (23/260) of people shaved the day before surgery developed an SSI compared with 10 % (26/260)

who were shaved the day of surgery. The relative risk of 0.88 showed no statistically significant difference between the groups with respect to risk of developing SSI.

Trials which compared hair removal with no hair removal prior to surgery, using either razors or a depilatory cream, demonstrated no statistically significant difference in SSI between the comparison groups. Current evidence suggests that patients who do not have hair removed are just as likely to develop SSIs as patients having hair removed using razors or depilatory cream, although this comparison is underpowered and one cannot confidently exclude a worthwhile benefit.

The review does not support the recommendations of CDC[13] or the Hospital Infection Society[47] who strongly recommend that shaving should be avoided unless completely necessary. While the earlier systematic review[15] and the Norwegian Centre for Health Technology Assessment state that no strong evidence exists either in favor or against pre-operative hair removal.

Using depilatory cream for hair removal resulted in significantly fewer SSIs than using razors (7 trials). This evidence supports the recommendations of the Hospital Infection Society that depilatory cream should be used as an alternative to shaving.

There appears to be no difference in the number of SSIs when patients are shaved on the day of surgery compared with shaving one day pre-operatively; however this comparison involved only 500 participants. There were no trials comparing the use of depilatory cream on the day of surgery or one day before surgery. RCT evidence does not support the CDC recommendations and the Norwegian Health Technology Assessment[14], who advocates hair removal immediately before surgery. It is not possible to support or

refute the recommendations of the Hospital Infection Society who recommend using depilatory cream the day before surgery.

Based on these observations Tanner J[53] et al concluded that

1. The review finds insufficient evidence for an effect of pre-operative hair removal on rates of SSIs and of the relative effects of shaving and depilation.

2. If it is necessary to remove hair then depilatory cream results in fewer SSIs than shaving with a razor.

3. There is insufficient evidence on the rates of SSIs when people are shaved the day before or on the day of surgery.

4. There is no research to indicate whether the place of hair removal (e.g. operating theatre, anesthetic room or ward area) affects SSI rates.

CDC recommendation for prevention of wound infection -

Preparation of the patient before operation-

A. If the operation is elective, all bacterial infections that are identified, excluding ones for which the operation is performed, should be treated and controlled before the operation (category I).

B. If the operation is elective, the hospital stay before the operation should be as short as possible (category II).

C. If the operation is not urgent and patient is malnourished, the patient should receive enteral or parenteral nutrition before the surgery (category II).

D. If the operation is elective, the patient should bathe (or be bathed) the night before with an antimicrobial soap (category III).

E. a) Unless hair near the operative site is so thick that it will interfere with the surgical procedure, it should not be removed (category II).

b) If hair removal is necessary, it should be done either by clipping or using a depilatory rather than shaving (category II).

F. The area around and including the operative site should be washed and an antimicrobial pre-operative skin preparation applied from the center to the periphery. This area should be large enough to include the entire incision and an adjacent area large enough for the surgeon to work during the operation without contacting the unprepared skin (category II).

G. For major operations involving an incision and requiring use of the operating room (or) the patient should be covered with sterile drapes in such a manner that no part of the patient is uncovered except the operative field and those parts necessary for anesthesia to be administered and maintained (category II).

Ranking scheme for recommendations:

A. Category I: Measures in category I are strongly supported by well-designed and controlled clinical studies that show their effectiveness in reducing the risk of nosocomial infections or are viewed as effective by a majority of expert reviewers. Measures in this category are viewed as applicable for most hospitals-regardless of size, patient population or endemic nosocomial infection rates.

B. Category II: Measures in category II are supported by highly suggestive clinical studies in general hospitals or by definitive studies in specialty hospitals. Measures that have not been adequately studied but have a logical or strong theoretical rationale indicating probable effectiveness are included in this category. Category II recommendations are viewed as practical to implement in most hospitals.

C. Category III: Measures in his category have been proposed by some investigators, authorities, or organization, but to date, lack of supporting data, a strong theoretical rationale, or an indication that the benefits expected from them are cost effective. Thus, they are considered important issues to be studied. They might be considered for implementation by some hospitals, especially if the hospitals have specific nosocomial infection problems, but they are not generally recommended for widespread adoption.

In our institute, all adult patients undergoing surgery have been receiving razor shave on the previous evening followed by a regular soap bath on the day of surgery. The extent of depilation, though varying with proposed surgery, generally extends from the nipple to the mid-thigh for abdominal procedures. The method followed has been detailed in the "Razor protocol" listed in "Materials and Methods".

As already stated, the estimated over all wound infection in our institute is about 20 – 25%. This is higher than that quoted by other studies which range from 4.7% (Cruse and Foord)[5] to 17% (Myburgh). Following the above literature review, a need to review the pre-operative protocol and evaluate the cream depilation with respect to razor shaving was felt. Thus, this prospective randomized study has been undertaken to study the effects / influence of the preparation methods on wound infection.

METHODOLOGY

Following is the detailed outline of the materials and methods used in this study of razor shaving versus depilatory cream for pre-operative hair removal in patients undergoing surgery for inguinal hernia. The study was conducted for duration of one year from March 2009 to February 2010 at KLES Dr Prabhakar Kore hospital and MRC, Belgaum.

SOURCE OF DATA- 60 patients admitted with inguinal hernia and undergoing surgery for the same at KLES Dr Prabhakar Kore hospital, Belgaum.

SELECTION CRITERIA:

- **Inclusion criteria-** All patients above 18 years of age, with uncomplicated hernia undergoing surgery for the same were included.
- **Exclusion criteria-** Patients with complicated hernia such as obstructed hernia, incarcerated hernia and strangulated hernia and patients with skin infections were excluded.

SAMPLE SIZE- Sample size of 60 was taken by the thumb rule.

STUDY DESIGN- A comparative study.

SAMPLING- The study involved comparison of two methods. A 1:1 test to control ratio was planned and random allocation made into one of the two groups.

A. Razor shaving group (RS)
B. Depilatory cream group (DC)

This study was approved by the ethical and research committee of J.N.Medical College, Belgaum.

RANDOMIZATION – Randomization was done using sealed envelopes. A total of 60 patients were randomized in two groups of 30 each and they were subjected to different techniques of hair removal

Group	No of patients	Technique of hair removal
1	30	Razor shaving (RS)
2	30	Depilation (DC)

METHODOLOGY-

One day prior to surgery one envelops was opened per patient to identify which group that patient belonged. Patients in shaving and depilation group were subjected to respective procedures 12 hours prior to the surgery. Patients in depilation group were subjected to sensitivity testing 12 hours prior to the designated time of hair removal. All the procedures were carried out in the ward on the night before surgery. The procedures were performed by personnel trained in hair removal by different techniques.

Shaving- Wet shaving was done using a disposable safety razor (Fig 3)

Fig 3- Materials used in razor shaving protocol

Fig 4 – Razor shaving protocol

A. Parts to be prepared exposed

B. Soap applied

C. Shaving being done

D. Prepared part after completion

Procedure: Patient was made to lie down on a table in the preparation room after taking bath. Sufficient lather is generated over the part to be prepared, using a guaze piece soaked in 5% savlon solution (Fig 4B). The lather was left for a minute to accomplish its softening mission before starting the shave.

Part was shaved using a disposable safety razor stroking in the direction of the lay of the hair. At the same time loose skin was stretched taught against the direction of razor stroking (Fig 4C). In between the strokes the razor was rinsed frequently under running water to remove the shaving debris from under the razor blade. After shaving, the skin was wiped clean with a towel, inspected, and any uncut hairs removed.

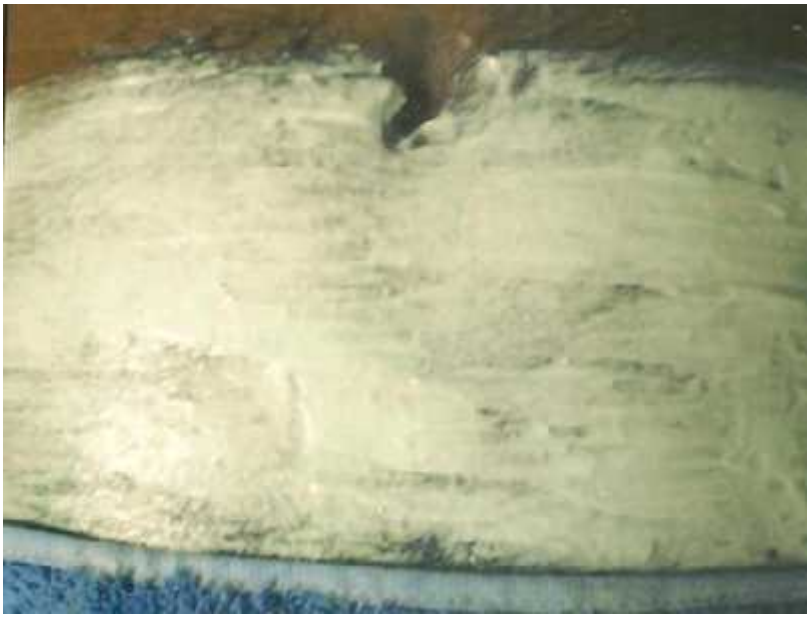
Depilation- Depilation was done using depilatory cream (Fig 5).

Fig 5 – Depilatory cream with spatula.

Depilatory creams: Commercially available depilatory creams contain keratinolytic agents like potassium thioglycolate with calcium hydroxide or calcium thioglycolate. They work by breaking the disulfide bonds the link the protein chains that give hairs its strength and thus making them disintegrate. We used depilatory creams containing potassium thioglycolate and calcium hydroxide.

Procedure: Patient in depilation group were subjected to sensitivity testing 12 hours prior to the designated time of hair removal. Patients not sensitive to the depilatory cream were subjected to hair removal at the designated time. A layer of about 2 mm was applied to the area to be depilated and left for 10 minutes (Fig 6 A). The cream was wiped away using a spatula and the area washed with water to remove traces of cream (Fig 6 B).

Fig 6 – Depilatory cream protocol



A.Cream being applied

B. Hair being removed after stipulated time

The degree of hair removal was simultaneously determined by the same observer, based on Likert type scale (as used by De Geest[41]) as follows:

0 – No hair growth

1 – Sparse hair growth (spa)

2 – Moderate hair growth (mod)

3 – Dense hair growth (den)

Fig 7- Hair distribution

A. Sparse

B. Moderate

C. Dense

The quality of preparation was assessed prior to surgery by same observer (Fig 8). The preparation was stated to be:

Satisfactory if:

1. There remained no hairs on the prepared site

2. There were no obvious injuries / damages to the skin integrity on the prepared surface. (Fig 8A)

Not satisfactory if:

1. Remnant hairs were seen on any part of the prepared area, especially close to elected site of incision

2. There were obvious injuries / damages to the skin integrity on the prepared surface. (Fig 8B)

Fig 8 – Quality of preparation

A. Satisfactory preparation

B. Unsatisfactory preparation

The time taken for preparation by either method was noted by the personnel preparing.

The post-operative orders were kept similar in either group. It consisted of antibiotics, analgesics and supportive. To avoid cofounding by antibiotic use, patients undergoing surgery received similar courses of antibiotics in either group.

The wound dressing protocol was also kept constant. The wounds were inspected on day 3 by an independent observer who will be kept blind of the method of preparation followed. If un infected, the wounds were opened directly for suture removal unless otherwise indicated. The infected wounds were dressed as and when needed. Wound infection was graded by a scale (used to that used by Powis[5]) as below:

Grade 0 – No reaction / sign of infection

Grade 1 – Red around suture line / sutures (redness / erythema)

Grade 2 – Local collection (red with serous ooze, purulent discharge)

Grade 3 – Partial wound dehiscence

Grade 4 – Complete wound dehiscence

The degree of hair growth, preparation and wound inspection have been done by the same observer in each of the cases entered into the study in order to avoid inter observer bias and confounding of results.

The relevant data were collected in the **"Data Collection Performa"** after taking **"informed consent"** as detailed in Annexure I and II

The data collected was then organized into "**Master chart**" as detailed in Annexure III to facilitate analysis of results.

Data obtained was tabulated and statistical analysis done using SPSS VERSION 14 software for:

1. Chi square test to analyze the rate of SSI in different techniques and timings of hair removal and $P<0.05$ was taken as significant.
2. Kruskal Wallis test to analyze the median patient and surgeon satisfaction scores with different techniques.
3. ANOVA test to analyze the mean time required for hair removal using different techniques of hair removal.

RESULTS

The present study comprise of 60 patients above the age of 18 years, undergoing surgery for inguinal hernia at KLES DR. PRABHAKAR KORE HOSPITAL AND MRC, BELGAUM, were randomized into two groups of 30 patients each. The findings are tabulated as below.

TABLE 1: STUDY GROUPS:

	RS GROUP	DC GROUP
MALES	28	21
FEMALES	2	9
TOTAL	30	30

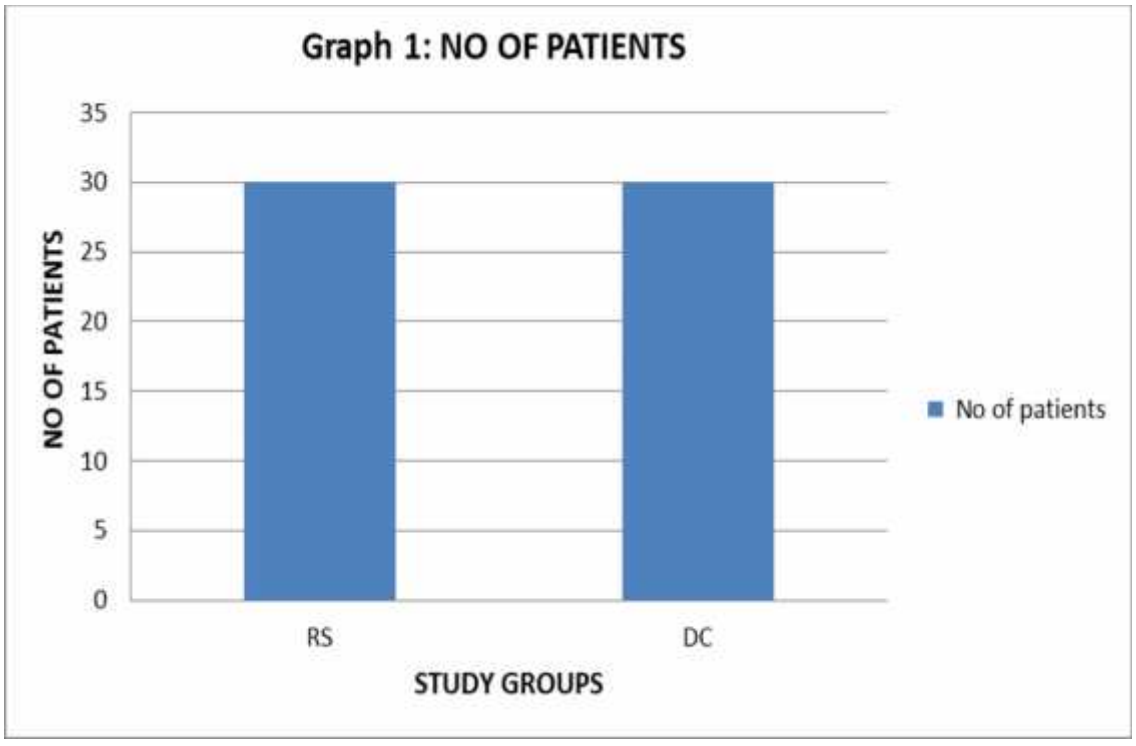


Table 1 and graph 1 shows the study group with number of patients in each group. There are 2 study group razor shaving group (RS) and depilatory group (DC) with 30

patients in each group. There were 28 males and 2 females in RS group while 21 males and 9 females in DC group.

TABLE 2: AGE DISTRIBUTION OF PATIENTS IN DIFFERENT GROUPS

AGE (YEARS)	GROUP 1	GROUP 2
18-27	1	4
28-37	5	14
38-47	7	4
48-57	4	4
58-67	6	1
68-77	5	2
78-87	2	1

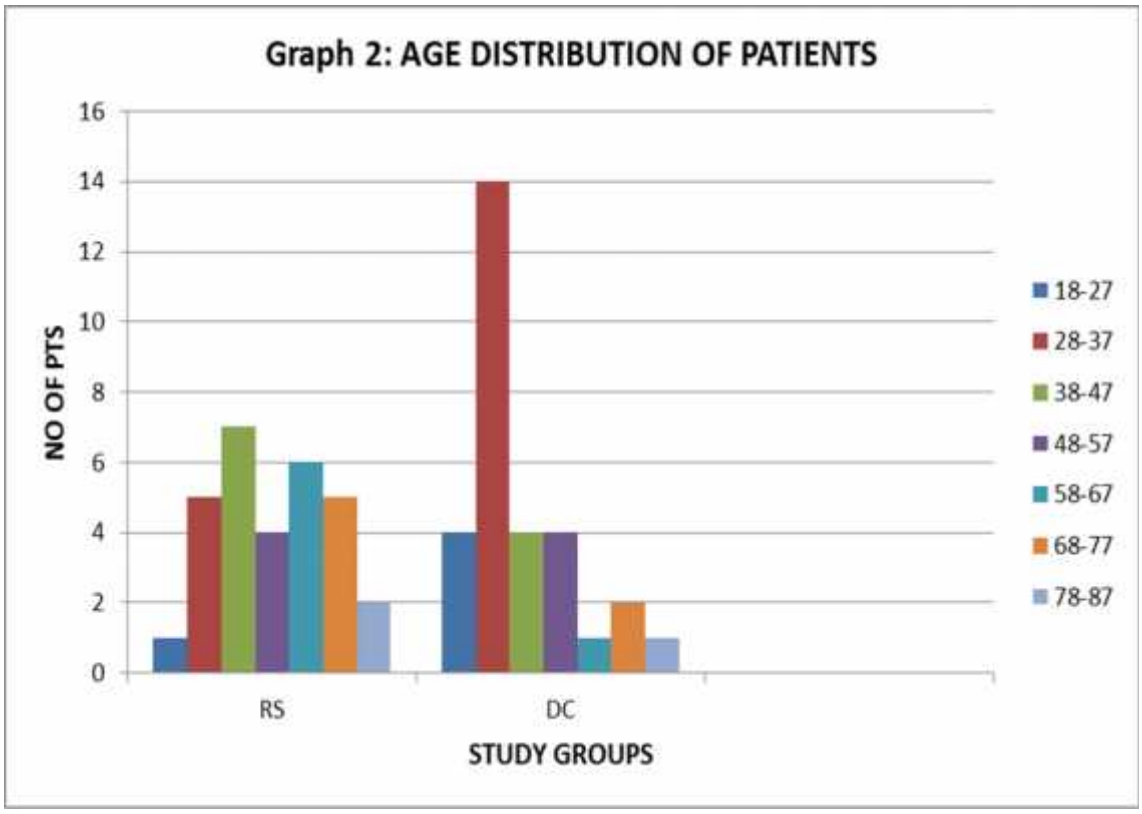


Table 2 and graph 2 shows age wise distribution of patients in both the groups. Majority of the patients are in the range of 28-37 years with youngest patient being 20 year old and the oldest patient being 79 year old.

TABLE 3: HAIR REMOVAL: RAZOR Vs. DEPILATION

Hair removal Method	Satisfactory		Not satisfactory	
	no	%	no	%
Razor shaving	25	83.3%	5	16.6%
Depilation	29	96.6%	1	3.3%

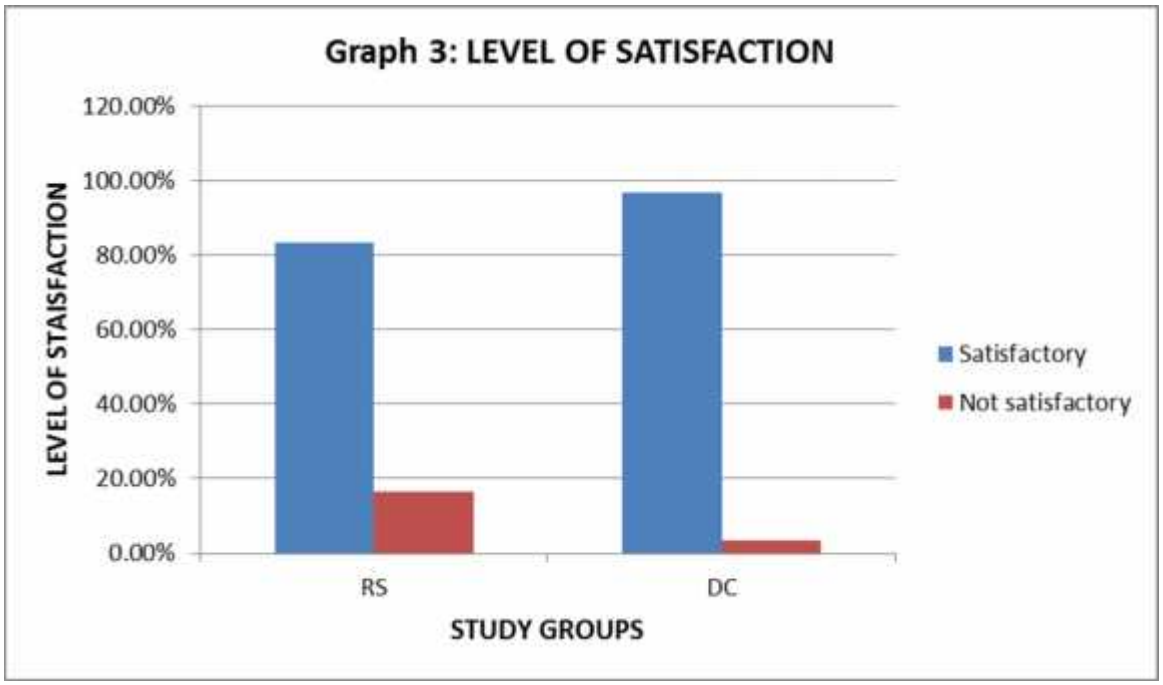


Table 3 and graph 3 shows rate of satisfaction by razor shaving vs depilation. The satisfaction rate in shaving group was 83.3% while it was 96.6% in the depilation group, suggesting that patients who underwent depilation had a higher satisfaction than the patients in depilatory group.

Patients with unsatisfactory hair removal in shaving group had abrasions and deep cuts

Patients with unsatisfactory hair removal in the depilation group had erythema.

Chi square test was done to determine whether there is significant difference in level of hair removal satisfaction in both the groups. It was found that the level of satisfaction in both groups was not statistically significant. (P=0.554)

TABLE 4: INCIDENCE OF POST OPERATIVE SSI

S.No	Type of preparation	Group	Total no of patients	No of SSI	% SSI
1	Razor shaving	RS	30	7	11.66%
2	Depilation	DC	30	1	1.66%

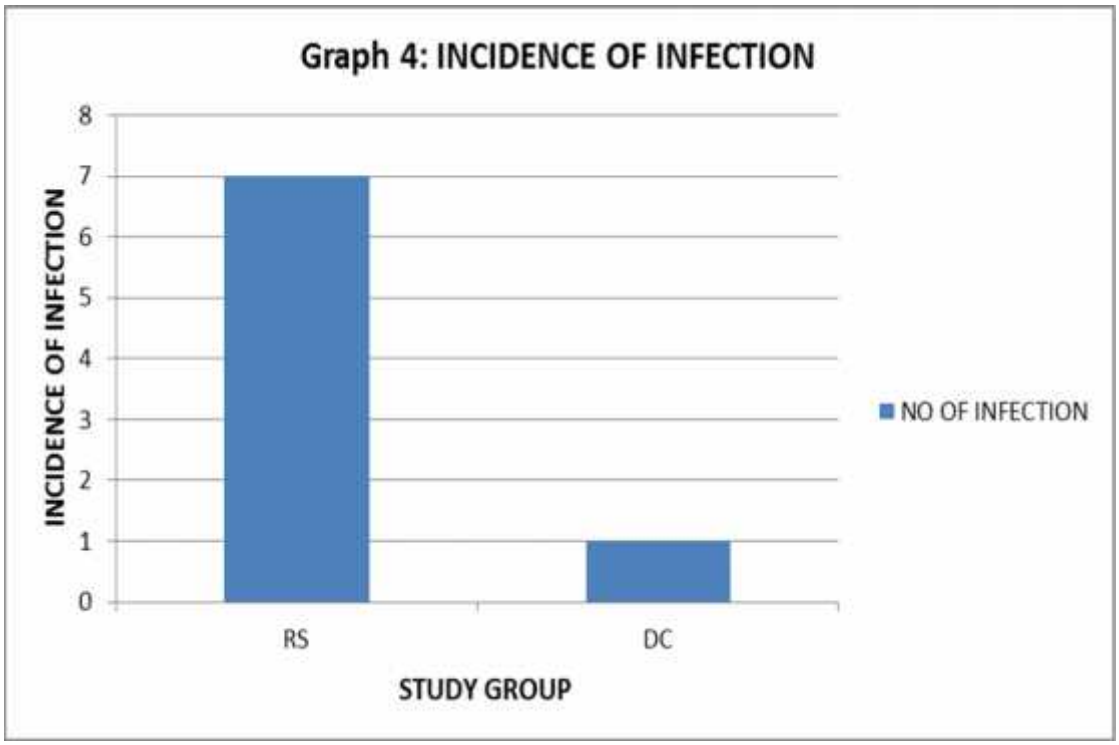


Table 4 and graph 4 shows the rate of surgical site infection (SSI) in both groups. A total of 13.33% (8/60) of patients had post-operative Surgical Site Infection.

Patients in RS group had incidence of SSI's of 11.66% (7) whereas patients DC group had incidence of SSI's of 1.66% (1)

TABLE 5: INCIDENCE OF POST-OPERATIVE SSI (GRADE WISE)

		WOUND INFECTION					Total
		Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	
Prep method	RS	23	2	3	1	1	30
	DC	29	1	0	0	0	30
Total		52	3	3	1	1	60

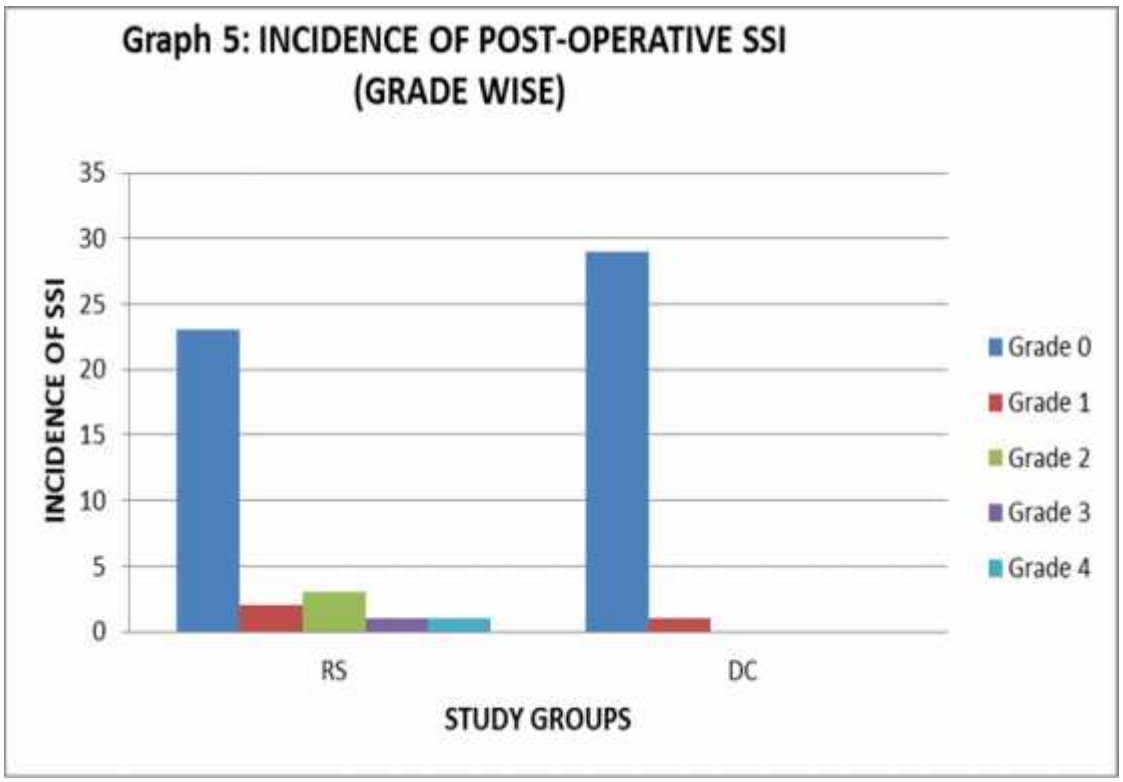


Table 5 and graph 5 shows grade wise infection rate in both the groups.

Patients in RS group had two grade 1 infection, three grade 2 infection, one grade 3 infection and one grade 4 infection. While patients in DC group had only one grade 1 infection.

Chi square test was done to determine whether there is significant difference in rate of SSI in both the groups. It was found that the rate of SSI in both groups are not statistically significant (P=0.094).

Table 6: SURGEON SATISFACTION SCORE

S.No.	Type of preparation	Surgeon Satisfaction Score		
		Good (3)	Satisfactory (2)	Poor (1)
1	Razor Shaving	9 (30%)	16(53.3%)	5(16.7 %.)
2	Depilation	20(66.6%)	9(30%)	1(3.3%)

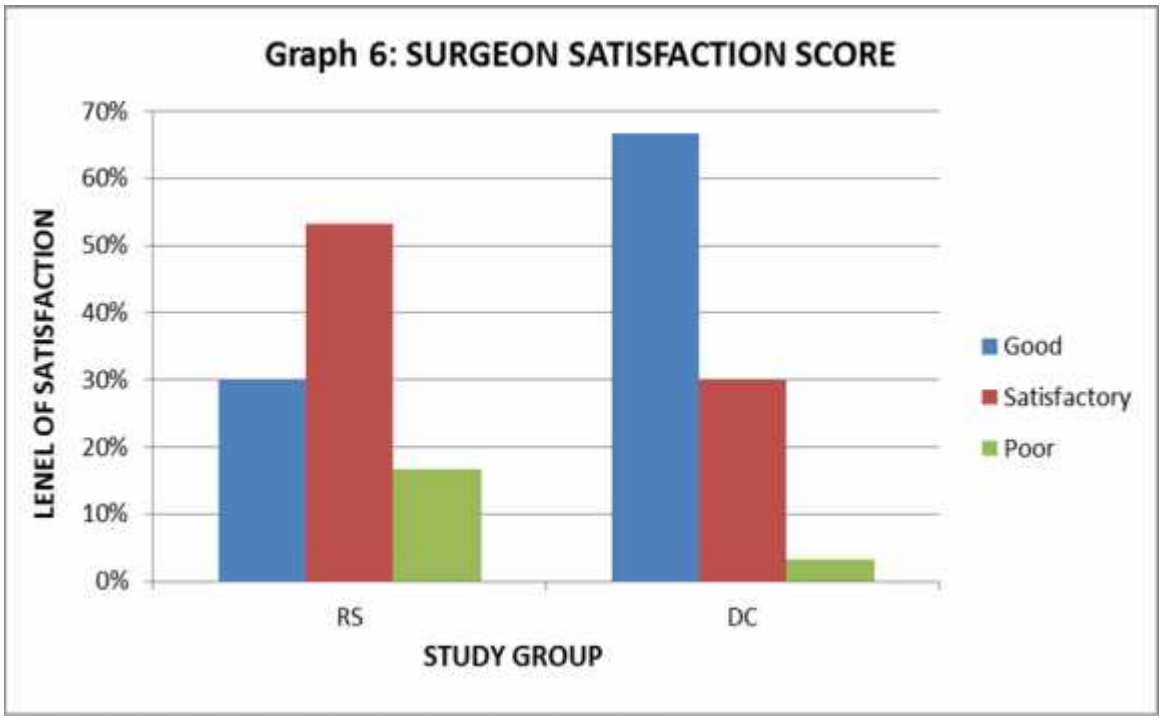


Table 6 and graph 6 shows surgeons satisfaction score.

The operating surgeon felt that the hair removal was good in 30% of cases in shaving group and 66.6 % in depilation group.

Non parametric Kruskal Wallis test was done to determine whether there is significant difference in median scores in both groups. The median score for RS group was 2.13 while the median score for DC group was 2.6. On comparisons with shaving and depilation, there was no significant difference found.

Table 7: TIME REQUIRED FOR HAIR REMOVAL

S.No	Group	No of patients	Mean time required (min)
1	RS	30	15.5
2	DC	30	25.1

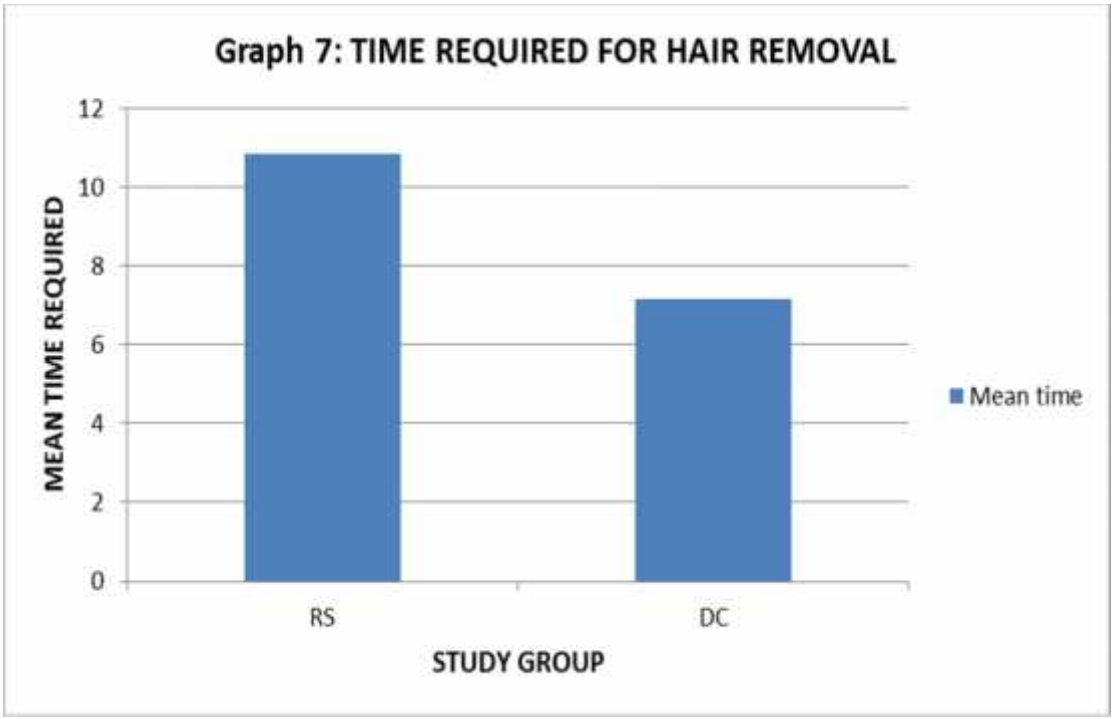


Table 7 and graph 7 shows time required for hair removal in both the groups.

Time required for hair removal was lower in RS group, with a mean time of 15.6 min min; while the mean time required in DC group was 25.1 min, suggesting that razor shaving is quicker than the depilation.

TABLE NO 8: COST OF HAIR REMOVAL

S. no	Area of preparation	Avg cost prep (Rs)	
		Shaving	Depilation
1	Umbilicus to mid thigh	10	30

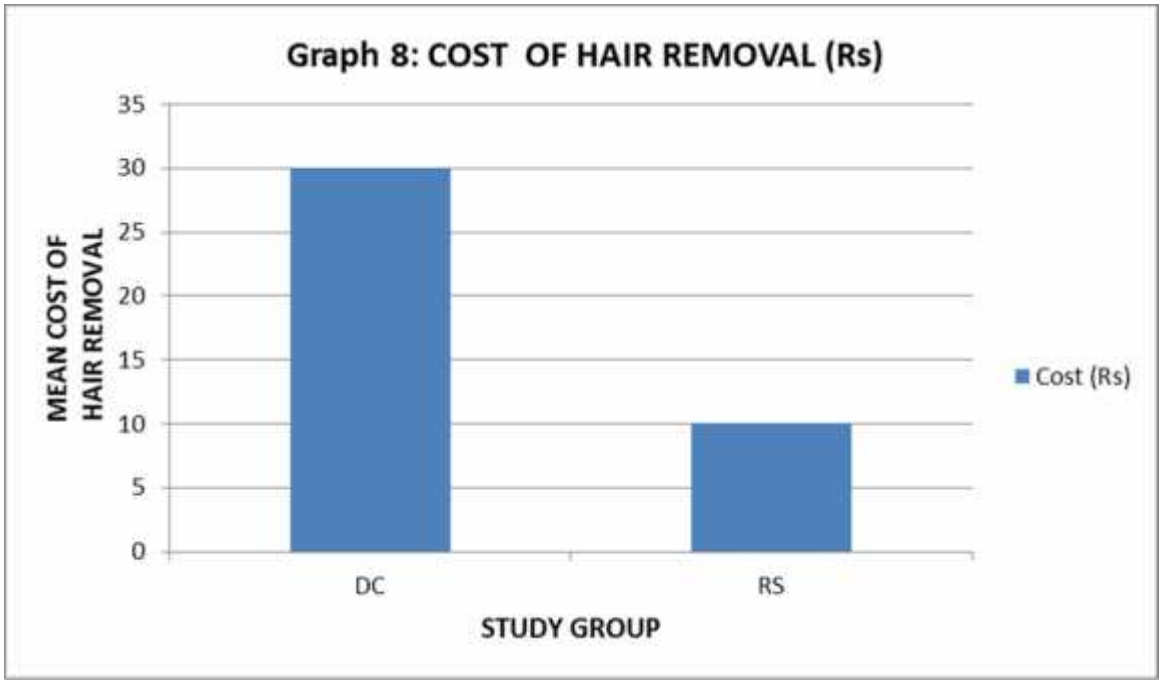


Table 8 and graph 8 shows cost of hair removals (for materials only).

Shaving costs ten rupees per patient while depilation was found to be costlier and was 30 rupees per patient.

DISCUSSION

Estimated wound infection rates of 20 – 25% have been observed in the last 10 years in the surgical wards, in spite of seemingly appropriate pre-operative preparation and prophylactic post-operative antibiotics, which have initiated a need to study the cause and source of such high infection rates. Previous studies taken up in the institutions favoring use of intra incisional antibiotic instillation before closure of wounds suggested wound contamination as the cause of high wound infection rates. It was thought that a review of skin preparation protocol could bring about reduction in the wound contamination from the skin. Review of literature showed the changing trends in skin preparation. So evaluation of alternate methods of depilation was planned. Depilatory cream was chosen as the alternative method due to easy availability and apparent lesser cost compared to other alternative methods like clippers.

An attempt is being made here, not only to compare the rate of surgical site infections associated with different techniques and time required for hair removal, but also to evaluate the efficacy, safety and cost of hair removal by safety razor and depilatory creams.

Sample size: During the study period of 12 months, 60 patients above 18 years of age, undergoing surgery for the inguinal hernia at KLES DR. PRABHAKAR KORE HOSPITAL AND MRC, BELGAUM, were randomized into 2 groups of 30 patients each. This study is to compare the two different techniques of hair removal and to compare the rate of infection along with additional parameters like surgeon's

satisfaction score, cost of hair removal, time required for hair removal, difficulties encountered by the paramedical staff removing the hair and post hair removal lesions.

Surgical site infection (SSI):

A total of 8 patients had post-surgical site infection (13.33%). Patient in shaving group had higher rate of SSI, 7 out of 30 (11.33%), while 1 out of 30 (1.33%) patients had SSI in depilatory group.

Rate of SSI is higher in shaving group with 13.33% (7/30) SSI, compared to depilatory group with 1.33% (1/30) SSI. The difference in rate of SSI in these 2 groups was statistically significant (P=0.094).

In seven trials [4, 32, 50-52] compare shaving with depilation, overall 10% (65/670) of patients who were shaved acquired an SSI compared with 7% (38/543) of people who had hair removed with a depilatory cream. This showed that patients are more likely to develop an SSI when they are shaved with a razor rather than having hair removed using a depilatory cream. Even in our study, we had the similar results with higher incidence of SSI in razor group, but the difference in rate of SSI was not statistically significant.

Surgeon Satisfaction Score (SSS):

The operating surgeon felt that the hair removal was good in 30%, satisfactory in 53.3% and poor in 16.7% in razor group with a median of 2.13, while SSS in

depilation group was good in 66.6%, satisfactory in 30% and poor in 3.3% of the patients with a median value of 2.53.

On comparisons between the razor group and depilatory group it was found that there is no significant difference in medians, suggesting that the surgeons were satisfied with both the groups.

The **acceptance of preparation by the patient** immediately following the preparation was evaluated by asking an open ended question. While majority were mentally prepared to undergo the ordeal of razor preparation, they preferred an alternative method. All patients who underwent depilatory cream preparation were happy because they did not have to go through a body shave. Most patients found the odor of the depilatory cream tolerable because of the pleasant fragrance. Since these were subjective feelings and could not be converted to numerical values, comparison of this is difficult. A Likert like scale to grade level of comfort might have helped but none was used in this study. So the impression remains subjective.

The personnel (nursing staff) acceptance of the depilatory cream preparation was encouraging. Most ward staffs were uncomfortable with razor shaving preparation but were following it because of lack of an alternative. After the initial reluctance to change they were very comfortable with the depilatory cream protocol. It was encouraging to note that even after the end of the study, the ward staff were more than willing to follow the depilatory cream protocol and were suggesting it, to affordable patients. One more added advantage of depilatory cream preparation noted in this study was self-preparation.

Time required for hair removal:

Shaving from umbilicus to mid-thigh took 15.6 min while depilation took 25.1 min. Time required for hair removal is significantly higher in depilation group compared to razor shaving, suggesting that hair removal by razor shaving was quicker than hair removal by depilation. De Geest[41] in her study had also found that depilation took a significantly longer time than the alternative methods. No other currently reviewed study mentions comparison of the preparation time between the two methods. The preparation time depends on density of hair at the site to be prepared

Cost of hair removal:

De Geest had taken the material costs, labor costs, type of nurse, and time of preparation into consideration for calculation of 'cost of preparation' for different methods employed. She found an initial moderate increase in cost to introduce the clipper / cream protocols but, a long term beneficial effect neutralized the cost. In our study it was difficult to set up a cost analysis plan as the institutional set up was entirely different[41]. However on rough estimation (material cost alone), it appears that the razor shaving protocol is cheaper compared to depilatory cream protocol. Average cost of razor shaving protocol was Rs 10 while the average cost of depilatory cream protocol was Rs 30.

Depilation was found to be costlier method of hair removal compared to hair removal by razor shaving.

CONCLUSION

This study has revealed that, shaving results have significantly higher rates of SSI as compared to depilation**,** though the difference is not statistically significant (P=0.094), suggesting that depilation is associated with lowest risk of SSI.

Depilation is associated with significantly higher patient and surgeon satisfaction score as compared to shaving, suggesting that both patients and the surgeons were more satisfied with depilation.

Depilation requires significantly higher time as compared to shaving, suggesting that razor shaving was quicker than shaving.

Shaving was found to be associated with increased incidence of local lesions in the form of abrasions and cuts compared to depilation, suggesting increased incidence of unsatisfactory skin preparation in RS group.

Depilation was found to be costlier than the razor shaving.

Thus, it is concluded that depilatory cream preparation is superior to razor shaving in terms of safety, satisfaction and efficiency of prevention of SSI. The cost and time needed for procedure though apparently higher compared to razor shaving, is not prohibitive for implementation. It can be safely followed with prior administration of 'skin test' and patients can be depilated any time before surgery without increased risk of wound infection. The possibility of 'self-administration' following patient education is also encouraging. This change in method of depilation needs to be incorporated with other recommendations outlined in the "Guidelines for prevention of wound infection, 1985" by the C.D.C., USA for efficient wound infection control.

Based on these findings we recommend that,

'Thus if Pre-operative hair removal is being done, then it should be done preferably using depilatory cream.'

SUMMARY

The present study was conducted in KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belgaum on 60 patients with inguinal hernias undergoing the surgery for the same.

The objective of the present study was to assess the efficacy of pre-operative hair removal by razor shaving vs depilatory cream in prevention of post-operative surgical site infection rate. Along with this the safety, cost of hair removal, patients preference, operating surgeons preference and personnel (nursing staff) response between hair removals by razor shaving vs depilatory cream was assessed.

The two groups were randomized into 2 groups of 30 patients each. One group underwent pre-operative hair removal by razor shaving while the other group by depilation cream.

Post-operative surgical site infection was higher in the group that underwent pre-operative hair removal by razor shaving than in the group that underwent pre-operative hair removal by depilatory cream.

With regards to safety, patients preference, operating surgeons preference and personnel (nursing staff) response pre-operative hair removal by depilatory cream was better than razor shaving. While the cost and time required for preparation was higher in the depilation group than razor shaving group.

Hence pre-operative hair removal by depilatory cream was found to be better than by the razor shaving.

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ANNEXURE f - CONSENT FORM

Title of research study:

"EFFICACY OF PRE OPERATIVE HAIR REMOVAL ON THE DAY BEFORE SURGERY BY ROUTINE RAZOR SHAVING VERSUS DEPILATORY CREAM IN PREVENTION OF POST SURGICAL SITE INFECTION IN PATIENTS ADMITTED WITH INGUINAL HERNIAS" A COMPARATIVE STUDY AT KLES DR. PRABHAKAR KORE HOSPITAL AND MRC, BELGAUM.

Principle investigator:

Dr. Devendra D Jalde

Post graduate student,

Department of Surgery, J.N. Medical College,

Belgaum.

Introduction and purpose:

To compare the efficacy of hair removal on day before surgery by routine razor shaving versus depilatory cream in prevention of post-surgical site infection in patients admitted with inguinal hernias.

Procedure:

1. Razor shaving-

   Materials used:

a) Razor blade

b) Disposable blade

c) Soap

d) Clean water

e) Clean bowl

f) Clean wool / guaze

g) Clean towel

Steps:

a) Explain the procedure to the patient

b) Undress to expose the parts to be exposed

c) Moisten the area to be prepared with clean water and apply soap

d) Shave the area to be prepared

e) Cleanse the shaved area with clean water

f) Advice the patient to wear clean clothes

2. Depilatory cream-

Materials used

a) Depilatory cream

b) Spatula

c) Clean water

d) Clean bowl

e) Clean wool / guaze

f) Clean towel

Steps:

A. Skin test

a) Choose 1 x 1 inch area over inner aspect of non-dominant forearm

b) Apply cream uniformly on the “test site”

c) Wait for the stipulated contact period (10 min)

d) Wipe to remove the cream

e) Wash with water

f) Observe for reaction

B. Preparation

a) Explain the procedure to the patient

b) Undress to expose the parts to be prepared

c) Ensure that the area to be prepared is dry

d) Apply cream evenly over the area to be prepared, using the spatula

e) Wait for stipulated time period (10 min)

f) Wipe the cream off the surface using a moist guaze piece

g) Cleanse the prepared part with clean water

h) Advice the patient to wear clean clothes

Voluntary participants / withdrawals

I Mr./Ms. _____ have been explained about the research study, the need of the study, the diagnostic intervention, their risks, benefits and alternatives available in my own vernacular language.

Taking part in this study is voluntary. I may choose not to take part in this study, or withdraw from the study anytime later. My decisions will not change the present or future health care or any service I receive. The study doctor or sponsor may stop my participation in the study without any consent. While taking part in the study I will be told of any important new findings that may change my willingness to continue or take part. If I choose not to take part in the study I will receive the standard treatment for patients with my conditions.

Cost: Nil

Compensation:

In the event of injury or complication related to the study, treatment will be made available to you through KLES Dr. Prabhakar Kore Hospital and MRC, Belgaum. There is no compensation or payment for such medical treatment by law. In case of any complication or injury please do feel free to contact Dr. Devendra Jalde PG M.S. General Surgery, KLES Dr. Prabhakar Kore Hospital and MRC, Belgaum Phone No.9986402123.

Confidentiality:

The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to others without your written permission except:

1. in emergency to protect your rights and welfare.

2. If required by law.

Authorization to Publish Results:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with you will remain confidential.

Consent to participate in the study:

I voluntarily agree to participate in this study by signing up this form below. I may withdraw at any time from this study. I am not giving any of my legal rights by signing up this form. My signature / thumb impression below indicates that I have read or information in the consent been read to me including the risks and benefits and have cleared my doubts. I will be given a copy of this consent form.

In case of any queries, you can contact the following:

Dr. V.D.Patil M.D., D.C.H.

Chairman,

College Ethical Dissertation and Research Committee,

J.N.Medical College, KLE University,

Belgaum – 10

Dr. P.S.Pattanshetti M.S.

Professor,

Department of Surgery,

J.N.Medical College, KLE University,

Belgaum – 10

Dr. Devendra D Jalde

Post graduate student,

Department of Surgery, J.N. Medical College,

Belgaum – 10.

Signature of the study patient:

Name of the study patient:

Signature of the legally authorized representatives:

Relationship to the patient:

Signature of the witness:

Signature of the investigator:

Date:

ANNEXURE ff - PROFORMA

Title of research study:

"EFFICACY OF PRE OPERATIVE HAIR REMOVAL ON THE DAY BEFORE SURGERY BY ROUTINE RAZOR SHAVING VERSUS DEPILATORY CREAM IN PREVENTION OF POST SURGICAL SITE INFECTION IN PATIENTS ADMITTED WITH INGUINAL HERNIAS" - A COMPARATIVE STUDY AT KLES DR. PRABHAKAR KORE HOSPITAL AND MRC, BELGAUM .

Date: Case serial no:

1. Patient particular:
    a) Name :
    b) Age :
    c) I P No :
    d) Sex :
2. Method of preparation :
    a) Razor
    b) Depilatory cream
3. Hair distribution :
    a) No hair
    b) Sparse distribution
    c) Moderate distribution
    d) Dense hirsute

4. Skin test :
    a) Not applicable
    b) Applicable
        i. Reaction
        ii. No reaction
5. Skin preparation :
    a) Time taken :
    b) Hair removal :
        i. Satisfactory
        ii. Not satisfactory
6. Wound infection grading :
    a) Grade 0 – No reaction / sign of infection
    b) Grade 1 – Red around suture line / sutures (redness / erythema)
    c) Grade 2 – Local collection (red with serous ooze, purulent discharge)
    d) Grade 3 – Partial wound dehiscence
    e) Grade 4 – Complete wound dehiscence
7. Special comments :

Sl no	Name	IP No	Age	Sex	PM	HD	SR	PT	HR	WI
1	Savitri A	329833	45	F	DC	Sparse	NR	15	S	Grade 0
2	Ningappa	330849	76	M	DC	Sparse	NR	15	S	Grade 0
3	Parvati C	342722	33	F	DC	Sparse	NR	15	S	Grade 0
4	Jaysri P	338968	32	F	DC	Sparse	NR	15	S	Grade 0
5	Laxaman Y	347318	32	M	DC	Moderate	NR	15	S	Grade 0
6	Mallapa H	348130	31	M	DC	Moderate	NR	10	S	Grade 0
7	Dilawar S	349504	53	M	DC	Dense	NR	25	S	Grade 0
8	Tukaram T	348362	36	M	DC	Moderate	NR	20	S	Grade 0
9	Azad H	351125	32	M	DC	Moderate	NR	15	NS	Grade 0
10	Ravindra A	339816	36	M	DC	Moderate	NR	15	S	Grade 1
11	Sameer M	327865	30	M	DC	Moderate	NR	15	S	Grade 0
12	Shivaji D	327872	22	M	DC	Sparse	NR	15	S	Grade 0
13	Ramchandra	325153	42	M	DC	Moderate	NR	15	S	Grade 0
14	Basavraj M	280890	25	M	DC	Moderate	NR	10	S	Grade 0
15	Maruti B	337983	20	M	DC	Moderate	NR	15	S	Grade 0
16	Vittal M	340851	36	M	DC	Moderate	NR	20	S	Grade 0
17	Vagharam D	335242	39	M	DC	Moderate	NR	10	S	Grade 0
18	Amar N	331997	25	M	DC	Moderate	NR	10	S	Grade 0
19	Narayan D	326244	79	M	DC	Sparse	NR	10	S	Grade 0
20	Virupaxi R	324239	70	M	DC	Moderate	NR	20	S	Grade 0
21	Ananda B	324921	51	F	DC	Sparse	NR	15	S	Grade 0
22	Ameena B	333860	50	F	DC	Moderate	NR	15	S	Grade 0
23	Basappa H	306872	65	M	DC	Moderate	NR	10	S	Grade 0
24	Nagraj K	313858	29	M	DC	Moderate	NR	15	S	Grade 0
25	Basappa H	313497	37	M	DC	Moderate	NR	10	S	Grade 0
26	Sunil K	310184	35	M	DC	Moderate	NR	15	S	Grade 0
27	Malava M	342651	44	F	DC	Moderate	NR	10	S	Grade 0
28	Chanama S	337101	32	F	DC	Sparse	NR	10	S	Grade 0
29	Roopa	306785	30	F	DC	Moderate	NR	15	S	Grade 0
30	Ameenabi	316453	52	F	DC	Moderate	NR	15	S	Grade 0
31	Appasab S	336274	35	M	RS	Moderate	NA	20	S	Grade 0
32	Bharmappa	325032	64	M	RS	Moderate	NA	20	S	Grade 0
33	Somaya Z	329820	63	M	RS	Sparse	NA	15	NS	Grade 0
34	Somanaik D	335832	45	M	RS	Dense	NA	25	S	Grade 1
35	Basayya P	347398	65	M	RS	Moderate	NA	20	S	Grade 0
36	Sripad B	350298	69	M	RS	Moderate	NA	20	S	Grade 0
37	Ningappa H	340818	67	M	RS	Moderate	NA	25	S	Grade 0
38	Somayya H	329820	45	M	RS	Moderate	NA	20	S	Grade 0
39	Shabir N	329893	30	M	RS	Moderate	NA	20	S	Grade 0
40	Jaysri P	339890	69	F	RS	Moderate	NA	25	S	Grade 0
41	Vasant N	326003	80	M	RS	Moderate	NA	25	S	Grade 0
42	Adam P	326063	42	M	RS	Moderate	NA	20	S	Grade 0
43	Afgan Patan	325052	75	M	RS	Moderate	NA	25	S	Grade 0
44	Vasant P	358043	70	M	RS	Moderate	NA	20	S	Grade 0
45	Shirhatti J	336579	60	M	RS	Sparse	NA`	20	S	Grade 0
46	Rajbalam K	325662	72	M	RS	Sparse	NA	15	S	Grade 0
47	Kedarnath	325662	72	M	RS	Sparse	NA	20	S	Grade 0
48	Md Gouse	327870	40	M	RS	Dense	NA	25	S	Grade 4
49	Gangadar P	306840	49	M	RS	Moderate	NA	20	S	Grade 0
50	Anil D	305047	53	M	RS	Moderate	NA	25	S	Grade 2
51	Fakirsab K	304076	66	M	RS	Moderate	NA	25	S	Grade 0
52	Laxman S	301917	50	M	RS	Dense	NA	25	S	Grade 3
53	Babu J	292218	47	M	RS	Moderate	NA	25	S	Grade 0

Sl no	Name	IP No	Age	Sex	PM	HD	SR	PT	HR	WI
54	Husainsab	322051	50	M	RS	Dense	NA	25	S	Grade 1
55	Chandru H	350634	38	M	RS	Moderate	NA	20	S	Grade 0
56	Christy F	345806	33	M	RS	Moderate	NA	15	S	Grade 2
57	Shivanand	344501	30	M	RS	Dense	NA	30	S	Grade 0
58	Nausad S	342248	37	M	RS	Moderate	NA	20	S	Grade 0
59	Shyam	314367	24	M	RS	Moderate	NA	20	NS	Grade 0
60	Appaji	324516	46	M	RS	Dense	NA	25	NS	Grade 2

Key to master chart:

IP. No	In patient no
PM	Preparation method
HD	Hair distribution
SR	Skin reaction
PT	Preparation time
HR	Hair removal
WI	Wound infection
DC	Depilatory cream
RS	Razor shaving
NR	No reaction
NA	Not applicable
S	Satisfactory
NS	Not satisfactory