Ayurvedic Inheritance of India
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Module - 5
Surgical Conditions
Lecture -14
Surgical Instruments

We will be discussing the very interesting topic of surgical instruments described by Susruta. This is one of the admirable legacies of Ayurveda widely acclaimed, reputed very greatly for the skill, for the innovation, etcetera in the design of surgical instruments.

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Now in this, I will be dealing with classification of the large number of instruments, the blunt instruments which greatly exceeded in number the sharp instruments, 100 blunt instruments called yanthras by Susruta. Sharp instruments 20 in number called Shastra, supportive instruments and the instruments as indicators of the status of technology and surgery in ancient India. I would like to spend some time on that general subjects; subject which flows out of these instruments.

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Now, the the very diverse type of operations which Susruta described, some of which we have referred to, they would call for a verity of instruments, a very different in design, very different in purpose and so on. The, all the surgical trainees, surgeons they had to familiarize themselves with the use of these instruments. That was one essential part of a surgical training. We have seen that students who wanted to train in shalya, in surgery, they had to spend a lot of time using experimental models in familiarizing themselves with the use of these instruments.

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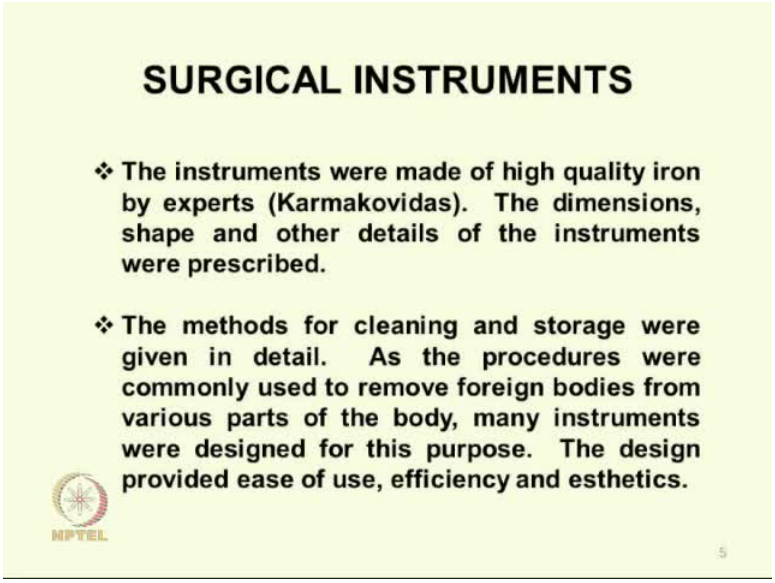

Susruta makes it clear that these instruments should be made of high quality iron; that is what he says, and they should be made by experts in the craftsmanship in this instrumentation, what he calls Karmakovidas - experts in the production or design and making of these instruments. The dimensions of the instruments, the shape, other details, how the surgeon should handle - All these are descried with great care. The method of cleaning the instruments after use, how to store them - all these are described in great detail, indicating the importance they attached to surgical instruments.

Most of the surgical procedures, a large number of them anyway, they had to deal with the removal of foreign bodies. In fact, 20 foreign bodies are described: splinters, arrow heads, etcetera and the removal of these from all parts of the body; sometimes, very awkward. All these had to be served by the use of these instruments. So, the design called for a good deal of ingenuity which we will see as we go along.

And also it indicates to have this kind of surgical armamentarium made. It required not only good craftsmen, a good quality of iron being available, but it also indicates there must have been a good deal of interaction between a very vigorous surgical profession and the craftsmen because craftsmen alone will not be able to design this. Because they have no idea what these are used for; the particular surgical application; whether it is removal of a bladder stone; whether removal of incising an abscess; these are very different purposes.

So, even today, company manufacturing surgical instruments, they always have surgeons as their consultants because they are the people who give ideas; what these instruments are used for; how they are used? So, similarly, in the Susruta’s time also, a very good group of craftsmen, a guild for example, and very good quality iron available. Those two will not produce surgical instruments. You need a very good source of surgical information; obviously, that also existed in Susruta’s time. That is a very important point.

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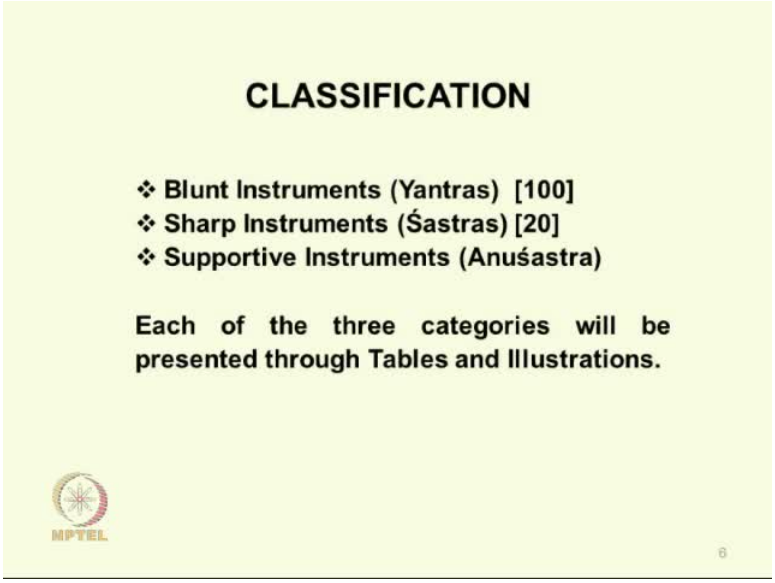

Now, in classification: blunt instruments, there are 100; sharp instruments, there are 20 and supportive instruments, there are large number of them. They are really not instruments, as you will see, many of them are materials which are used.

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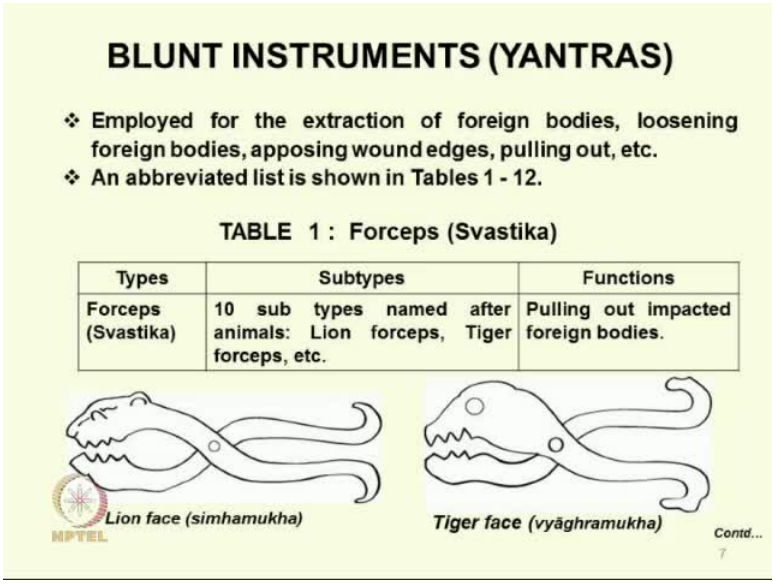

Now here, you can see the blunt instruments. What I have done is try to group this as best as I could. These are used essentially for extraction of foreign bodies in various parts of the body; loosening of foreign body if they are impacted inside; opposing the

edges of wound before suturing; pulling out things, and so on. So, these are various proposes for which these forceps are used.

Now, the first group of forceps: There are 10 of them. Forceps is the general grouping. Svastika and subtypes; there are 10 subtypes. Now, each of these the functions are pulling out impacted foreign bodies. They may be sprinters, some of them may be may be very fragile like glass for example, you have pull out with great care; otherwise, it may splinter. So, each of these will have a different propose, different type of a usage. But what you should observe here? One is it is user friendly because obviously these are designed in consultation with the user; so, they are user friendly; users know how to use it. And secondly, there is a lot of aesthetic in this because all these instruments. for example, in the first 10 sub types, there are all the business end of the instrument is shaped after animals which are very familiar. For example, the first one lion face that basically you can see here; the next one is a tiger face. Now, this is how all these instruments the business end is named after a particular animal and that animal is well known to the Indian people. Now, this lion face - the first one, next is a tiger face, and we go on.

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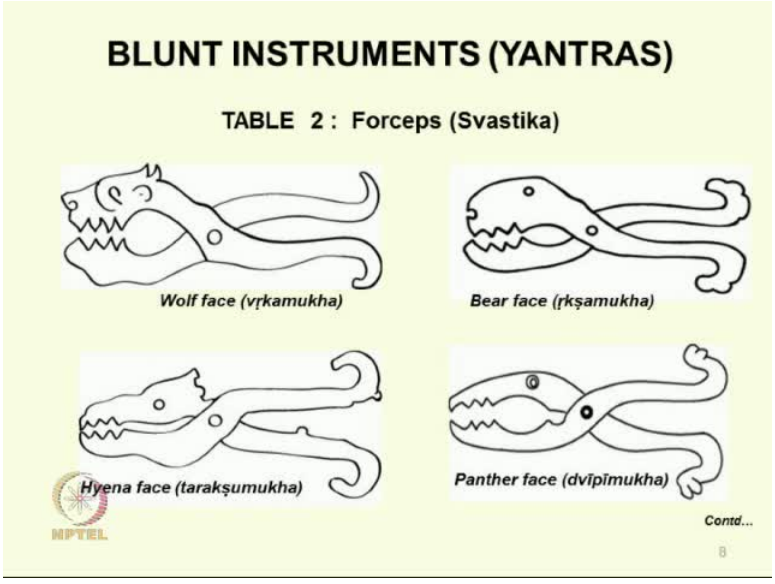

Next is wolf faced, bear faced, hyena faced, panther faced. So, these are all different type of business end of the instrument; it gives a good grip on the foreign body. If it is impacted, they have a good grip, they can pull it out. And the way it is shaped, it can go

into different body cavities, different muscles or tendons, joints, wherever it gets impacted they get hold of it and they can pull it out, and it is the surgeon's discretion to use which particular instrument that they should use. So, these are all the Svastikas which are used for this purpose.

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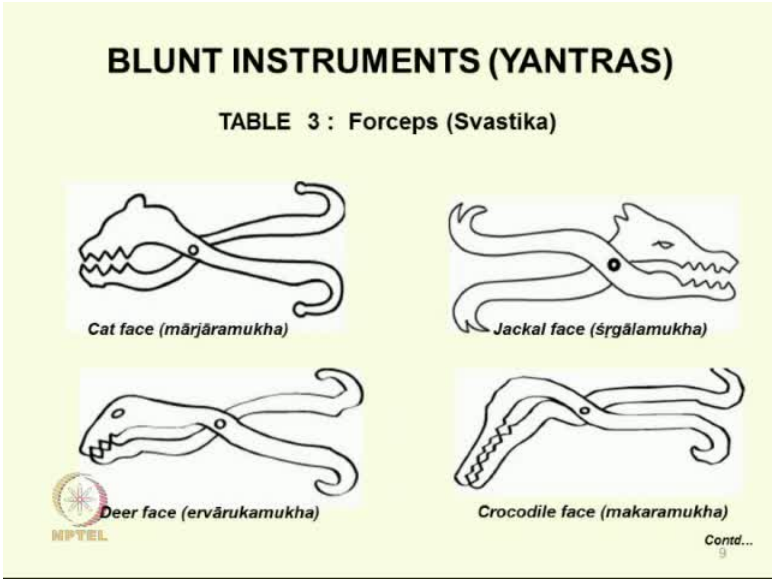

Then, we come to cat face, jackal face, deer face, crocodile face. Each one of them, you can see how ingenious they are; there is a lot esthetics also in this. It is not only a utility, the user friendliness, but also the aesthetics of design.

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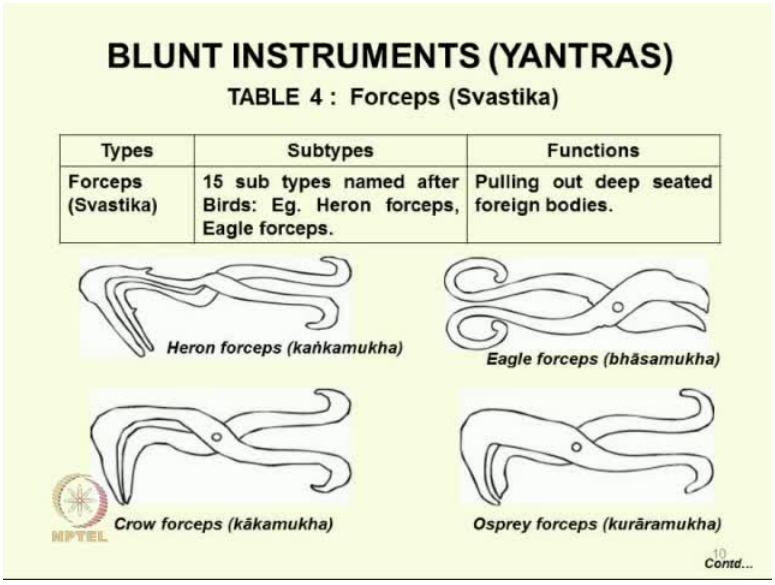

And we go on to Heron forceps. Now, here there are 15 types. They are of different kind because these are used to pull out deep seated foreign bodies. That is where they are bird faced; mostly they have shaped after birds. Here, heron forceps, eagle forceps, crow forceps, osprey forceps. Now, the earlier ones were all based on animals and here they are all birds. So, the design has changed.

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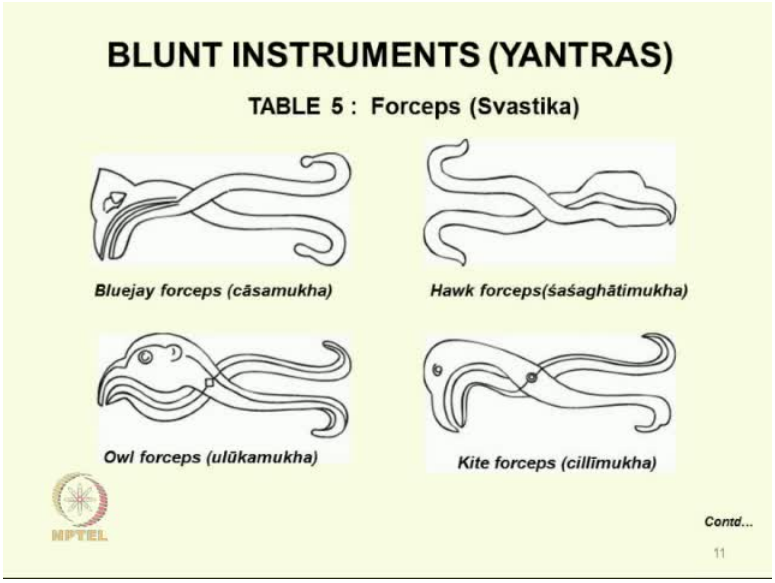

And Bluejay forceps, hawk forceps, owl forceps, kite forceps.

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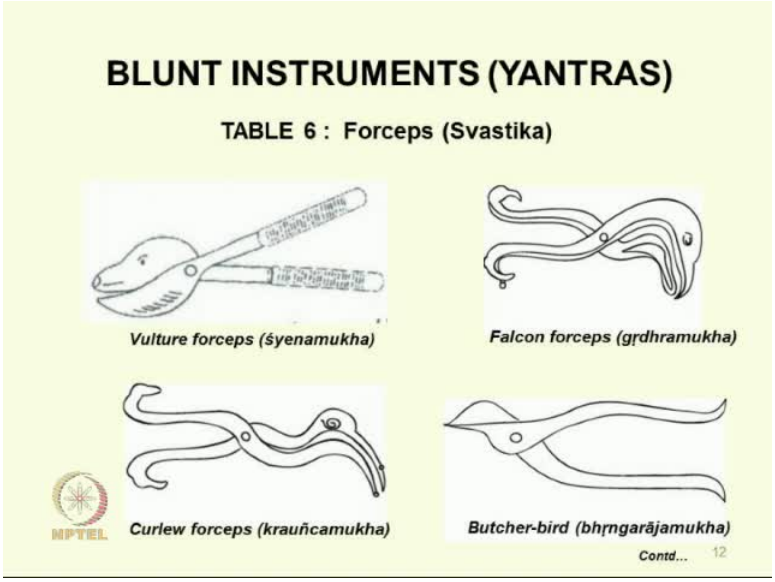

Vulture forceps, falcon forceps, curlew forceps, butcher-bird forceps; so, you can see how the great verity of the forceps used for a variety of purposes taking out from the surface or from depth.

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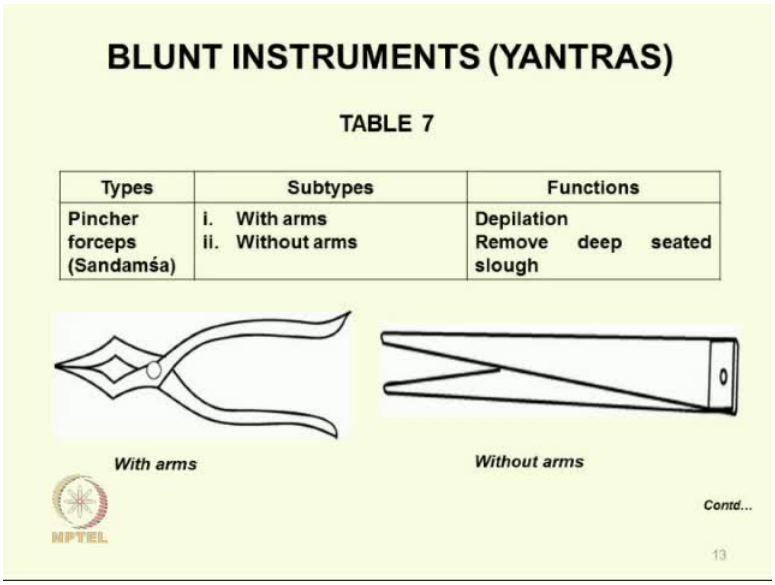

Now, here we move to the next category. It is also forceps, but it is Sandamsa, which is a different purpose. It has, may have two arms or it may be without arms, but these are used for other purposes like depilation, removing hair, or remove deep seated slough. Suppose, there is an ulceration going on; dead tissue is at a depth; you do not need tough big forceps to pull it out; it is too fragile; so, you might use this forceps here; without arms Sandamsa that could be used. So, that is another type.

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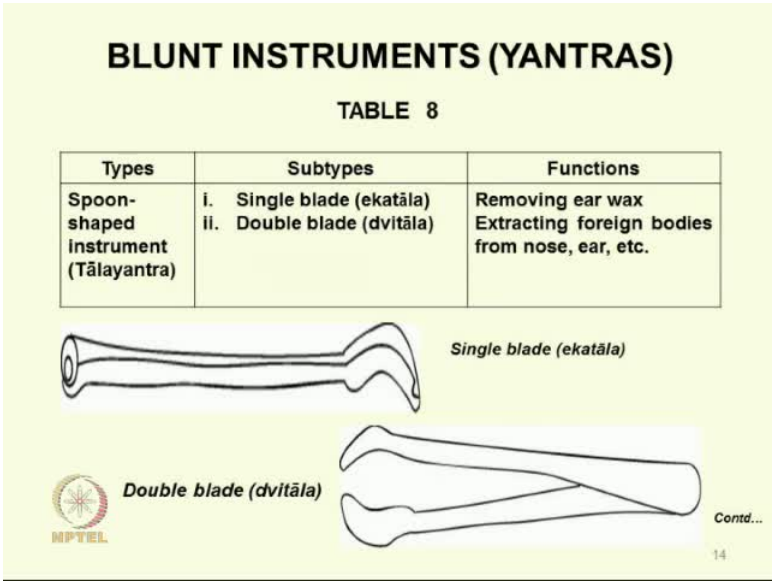

Then, we come to Talayantras which is a different propose all together. These are used for removing wax from the ear for example, or extracting foreign bodies from the nose in children or ear. There it is a different purpose all together. It may be a single blade ekatala or it may be double dvitala. So, these are two different types. They are also forceps, but different from what we have seen earlier.

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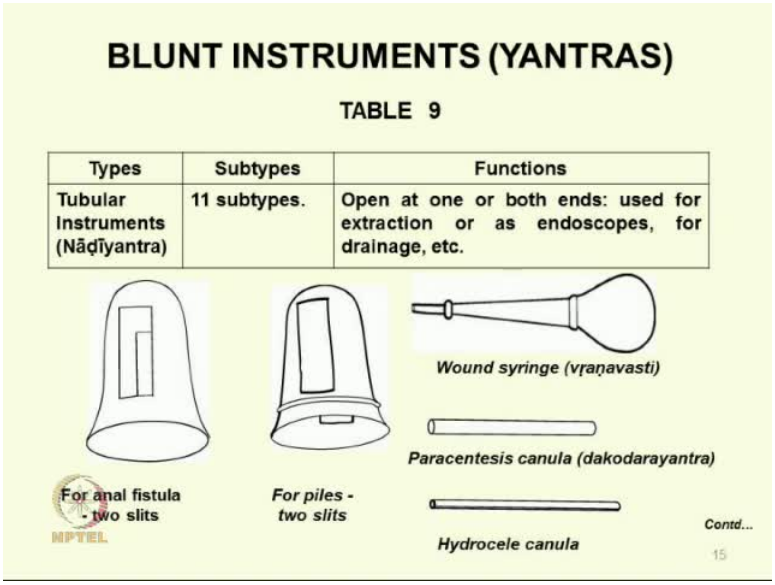

Then we come to another kind of blunt instruments. These are Nadiyantras. They may have openings at both ends or it may be only one side. And the most familiar and

important are these what we called tubular instruments which are used for visualizing endoscopes, today's term, to visualize the interior of the body cavities. The most commonly used are anal fistula and piles. For these two common conditions, for which surgical operations or procedures may be required, you use these Nadiyantras.

Now, here we have two instruments looking very similar to each other. On the left hand side, we have the anal fistula instrument with two slits, and on the right hand side, we have the piles instrument, again with two slits. Now, these instruments essentially very similar, but the difference is for the piles Arsho yantra, the two slits are wider because when you proceed on operating on piles, you need more space to operate; you have to put in instruments and you may have to do manipulation; you may have to do excision and so on. You may have to turn it around and see whether it is effective; then you have to turn it back.

A certain amount of manipulation is necessary, more in the case of the piles instrument than in the case of the anal fistula instrument. So, that is the only difference in the depth it should go and also the size of these slits, that is the only difference otherwise they are very similar. They look alike, but the purpose is somewhat different. Whereas anal fistula, you do not have to do so much of visualization inside; most of the operation is done on the anal verge or outside. So, the procedure is somewhat different in the case of pagandhara or fistula; whereas in piles, you have to do manipulation through the slit of the instrument.

When it comes to the wound syringe that is used for irrigating areas of the body inside, it can even be used through these endoscopes, if necessary. For example, the inner opening of a fistula, if you want to irrigate it after a particular procedure, you can use this wound syringe, Vranavasti; that is the term which is used for that. Then, we have other tubular instruments. One of them is Paracentesis or tapping. Tapping is if you have a collection of fluid in the abdomen, what is called dropsy. If you want to drain that fluid, this small skin incision is made and through that this Nadiyantra is introduced so that slowly you can drain this. It is very important that you do not drain it all together quickly because that can produce danger. So, essentially it is a small tube through which the drainage takes place very slowly. That is how the Nadiyantra for Paracentesis, for trapping the dropsy in the abdominal cavity. A similar instrument still smaller is used

for tapping hydrocele, which is also a collection of fluid. It should be drained slowly and that again is a similar instrument Nadiyantra.

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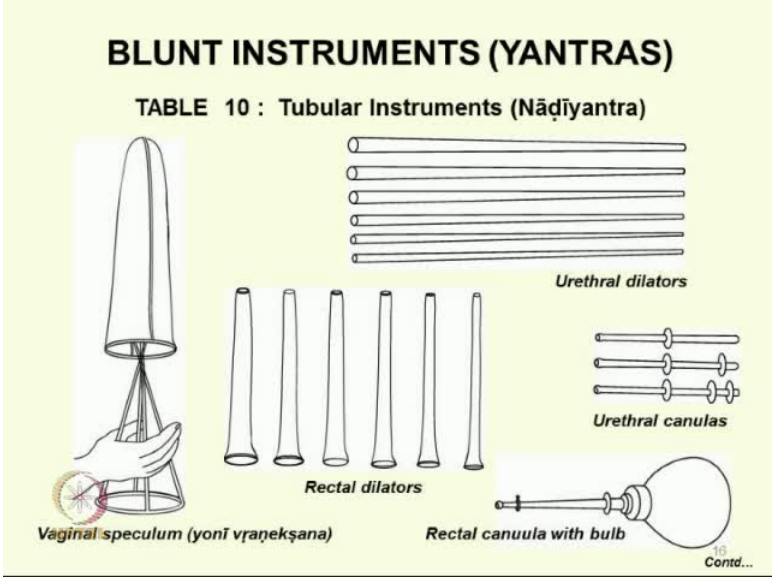

Now, here, you have a whole lot of these tubular instruments. On the left hand side is a vaginal speculum because that was used for irrigating the vagina for various disease conditions. Then, on the right hand side, you see urethral dilators; these are not tubes; they are blunt instruments. In other words, say entire it is a solid tube of different dimensions starting from very small to larger diameter. This tells us immediately that in those days urethral stricture was not uncommon. Urethral stricture, the most common cause is gonorrhea.

So, one has to assume that if you urethral strictures were dilated with these instruments, there must have been gonorrhea at that time; there must have been urethral stricture; otherwise, these dilators are hardly ever used. And similar type much less used is the rectal strictures and there again a similar rectal dilators are used. These are not tubes; they are solid rods; they are used for dilatation again.

These are repeatedly done. You cannot cure the stricture by using this, but patients get substantial relief, but they have to come again after some time for another process of dilatation.

Urethral cannulas: Again, if you want to drain urine through a narrowed area, you can use this urethral cannula and once again like irrigation a bowl with a tube so that you can irrigate urethral just like the rectal cannula.

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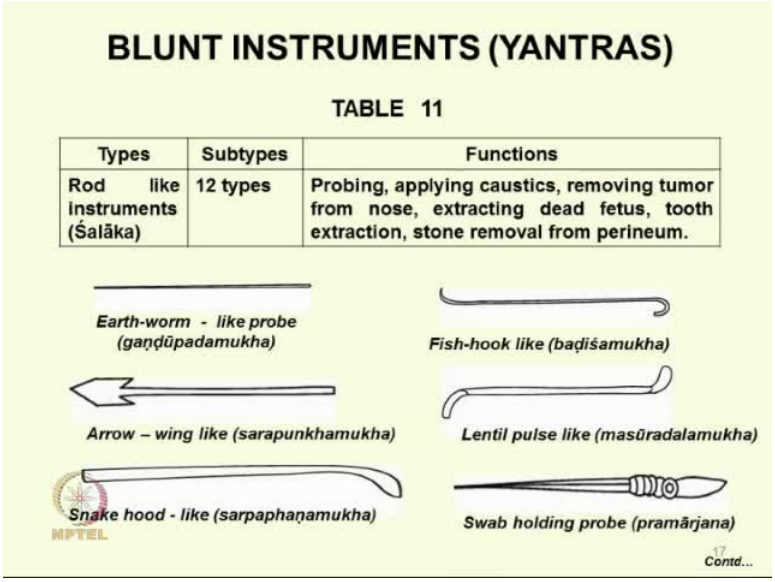

Then we come to Salakas. These are solid rods which are used for various purposes, for example, and all shaped very differently earthworm like probe. These are probes. If you want to there is a a sinus, a channel and you want to know which way that channel is going; you want to probe it. Now, it is that kind of purpose that you feel there is a foreign body somewhere, can you track it somehow using an instrument. These are, these kind of purpose that these rod like instrument Salakas are used; earthworm like, fish hook like, arrow wing type; so many lentil pulse like, the blunt tip so that it does not do any damage. Whereas, the arrow head if you have to go through a narrowed area you have to use some pressure; there are no vital structures; then a blood instrument can hardly go through that fibrous stricture area. You need something sharp, you would use the arrow wing tip, snake hood tip and swab holding probe. So, all these are, the tips are different depending on what you need; whether it is a blunt tip, can be used preferably you would use that; a sharp tip is necessary you would use that, but these are all essentially Salaka type of instruments and that is another type.

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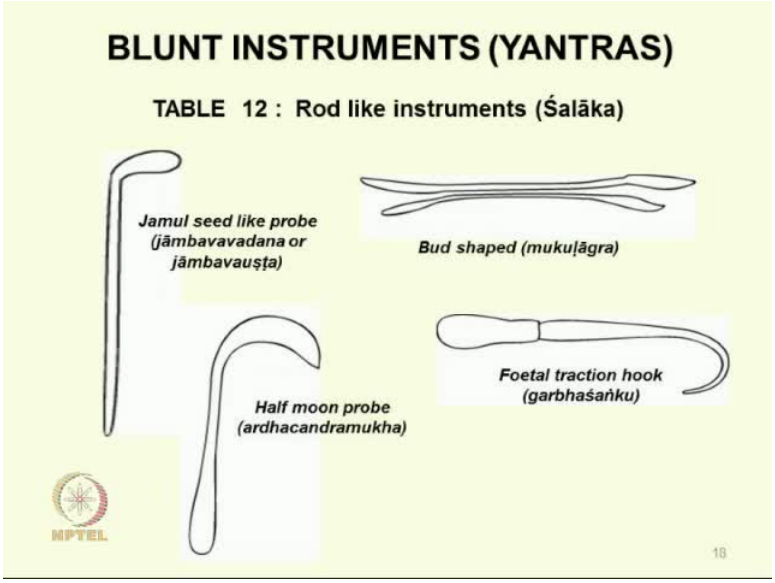

And we go on with more Salaka type and you may also recall that this Salaka simply means the rod. This is what was used in Jivakas examination in Takshashila. At that time, the Jataka tales talk about an examination. When a patient has to a student has finished his training, he has to subject himself to a test. And what was the test? A theoretical test was in an assembly of students and scholars sitting around. The student has to come and a text would be kept there with a Salaka; it is called Salaka test on a particular page.

So, he has come and open this and whatever he sees there, that subject he has got to discuss to the satisfaction of the assembly. Must have been a Salaka something like simply a rod which was kept there. So, Salaka name is quite famous that way in Ayurveda. Now, here again, there are used for a whole variety of purposes like a Jamul seed, the tip, a bud shaped tip, half moon shape tip and fetal traction hook; that is an important purpose because if you have a dead fetus, that is a very serious condition; women is very sick and fetus is dead; it is struck inside. How do you take it out? This is one of the most dangerous procedures and the surgeon had to get special permission from the king to do this. And if you have to take out that obstructing fetus, often you have got to suppose the shoulder is obstructing, with the knife he has to cut that shoulder, and to extract that fetus, he has to have a good grip and that is where he would use this foetal traction hook; that is introduce a good grip on the fetus body, some part and then it is extracted. So, it is used for that purpose.

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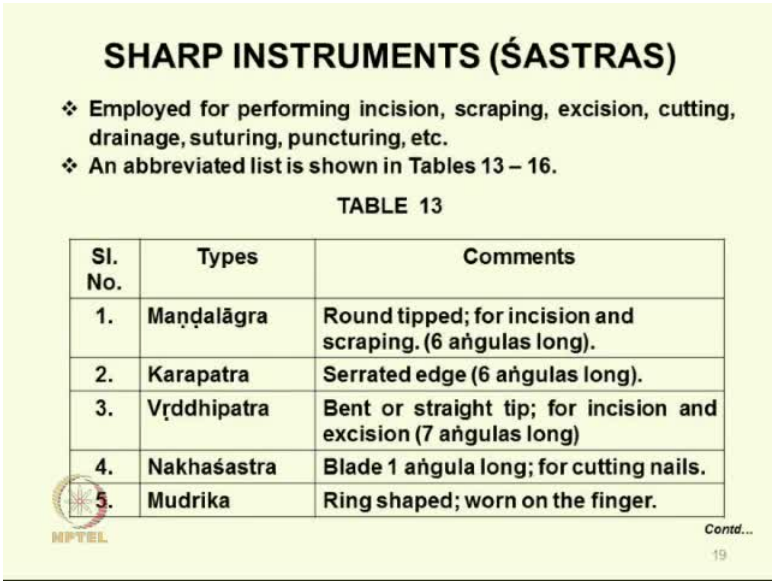

Now, we come to the, these are all examples of blunt instruments. I have taken examples from different categories: solid instruments, tubular instruments, forceps and so on. Now, we come to the sharp instruments. These are 20 in type. One is Mandalagra which is a round tipped knife such as we do not use it very often, but in those days, it was a very commonly used instrument for incision and scraping it was used. And it was six angulas long.

An angula is the width of a middle finger of an adult, average adult. That was the measure that was used for every instrument that the dimension is mentioned. Then Karapatra - serrated edge; this is used to for example, you have to divide a bone, this was the Karapatra was used. Vrddhipatra bent or straight tip for incision and excision. Nakhasaastra which was for pairing nails and Mudrika was a knife which was put around the finger so that you can use it, manipulate it and cut as you like. These are not instruments we use now.

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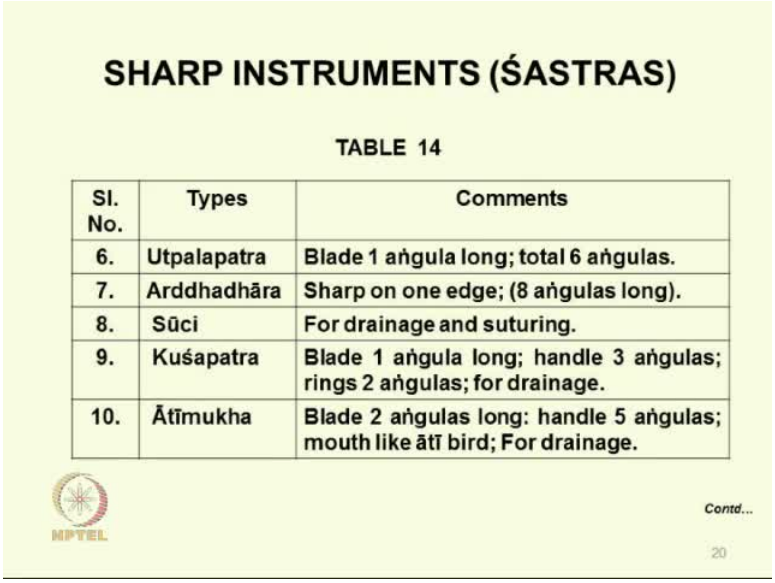

Utpalapatra blade - one angula long, total length is six inches. Arddhadhara, that is the you will see a picture of that; inside there is a sharp flat, on the outside it is curved; that is a very, the blades are very peculiarly shaped. You will see that six angular long. Suchi - different types needles, curved needles, straight needles etcetera. Kusapatra - again blade one angular long; handle is three angulas long; it is used for drainage. Atimukha - it is the shape of a of a bird. The mouth is faced like that; it is used for drainage again.

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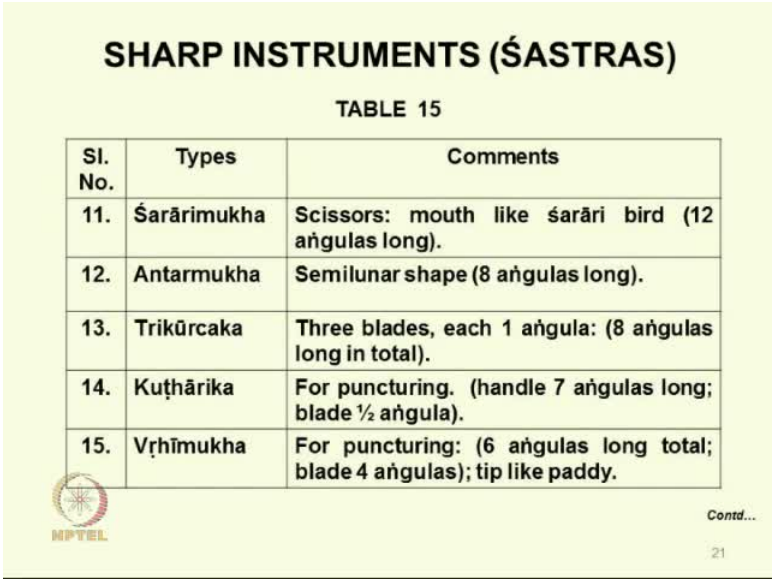

Sararimukha - scissors, mouth like Sarari bird. Antarmukha - semilunar in shape, eight angulas long. Triorcaka has three blades. So, these are different types of sharp instruments. Then kutharika, it is used for making puncturing and vrhimukha is for puncturing again. The tip is placed like a paddy; that is why it is called vrhimukha.

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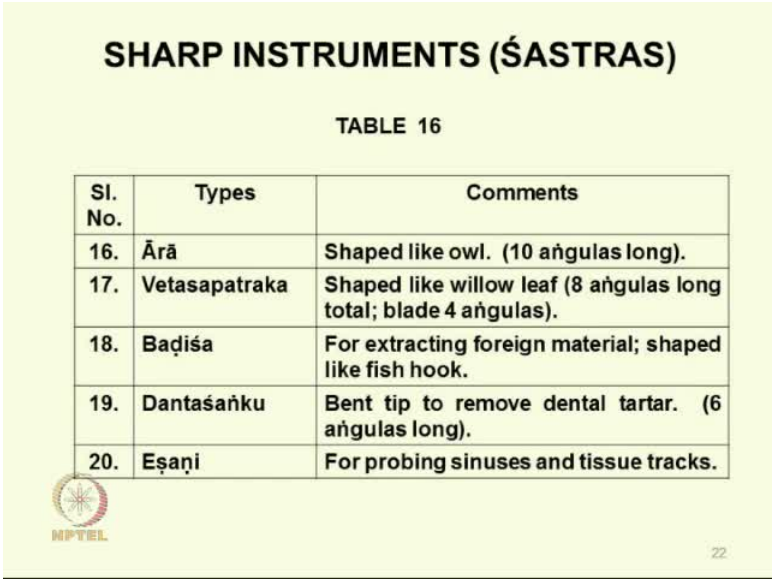

Then Ara shaped like an owl. Vetasapatraka shaped like a willow leaf. Badisa is again taking a hook, especially used for taking out foreign materials which are impacted. Dantasanku is a dental scalar and Esani is again a probe used for probing. Many of them are same propose, but often as surgeon, you will find a particular sinuous tracking one particular probe does not work, you may have to try something else. So, a certain amount of choice has to be available in the use of these instruments. Similarly, scissors; all these one single instrument design will not do; you have to have a variety available to suit a particular purpose.

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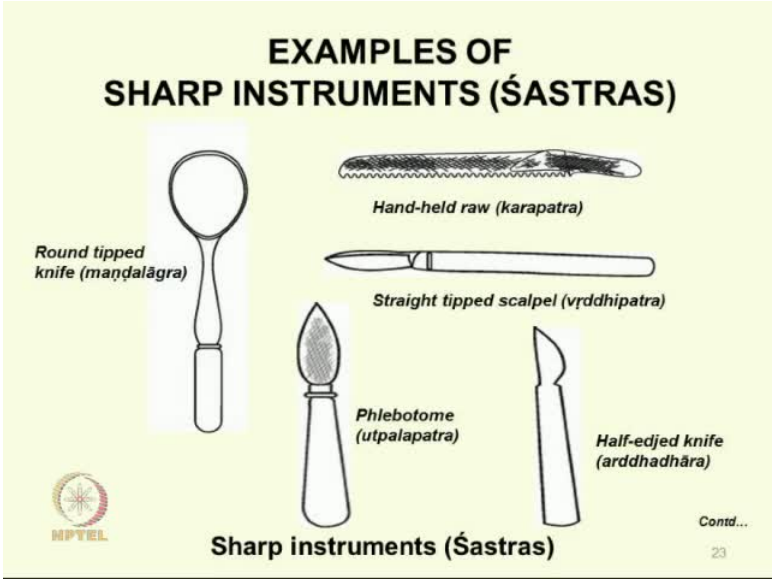

Now, here are the examples. This is the first one you see, the Mandalagra, that circular knife. Then, the Karapatra which is used for sawing the bone, straight tipped scalpel, then phlebotome; we talked earlier about how to do phlebotomy. A small skin incision is made on a exactly over a vein which is made prominent and through that only the vein is drained. Now, this is used for that with a sharp tip and there is a half edge type which is also used for a similar purpose making very small precise incisions.

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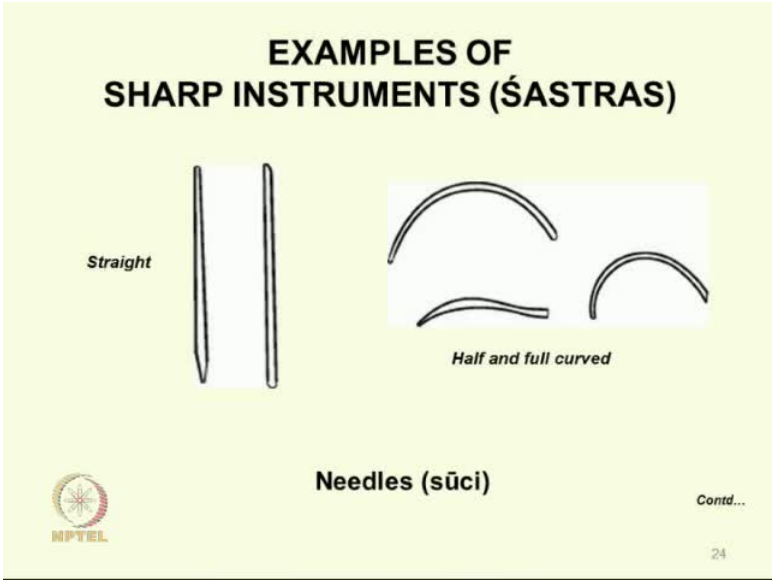

Then the different types of needles suci; a straight needle on the left, the full curved half curved, different types of needles, and the tips are also different. That curved needle, if you look, that is a round body needle, whereas the one below that, it has got a three edges to the tip; so, that is a much sharper. If you want to pass your needle through hard tissues like tendons, ligament, then you would use the one with a three edges.

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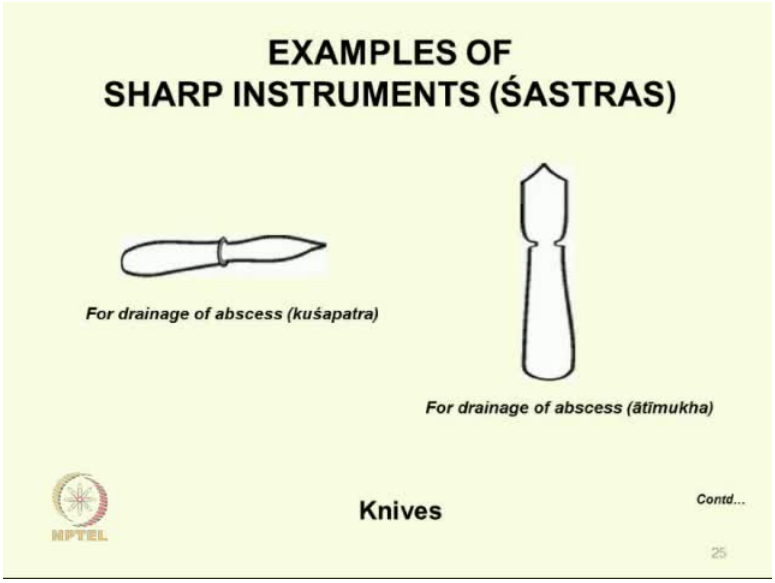

Now, this again is the, for drainage purposes; small incisions are to be made; both are used for a similar purpose.

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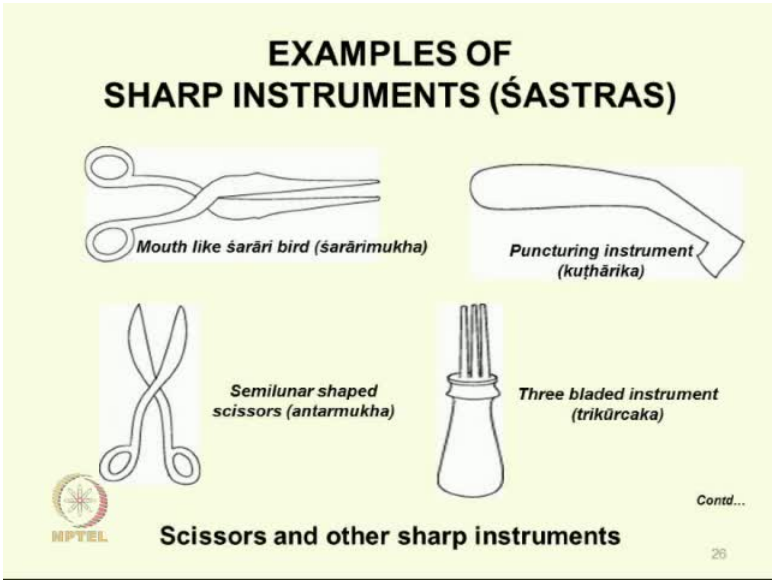

Now, here are scissors. Again, the mouth is based on the shape of birds; Sarari bird. This was the favorite of the design of birds or animals; puncturing instruments - Kutharika, and semilunar shaped scissors, Antarmukha - the flat inside and a curved outside. So, obviously, it is to introduce into some body cavity and cut. It looks like it is designed like that. That curved exterior. Trikurcaka is a three bladed instrument.

Now, then we have a Choker. Choker is used for making a puncture, for drainage purposes. All, All is used for making, if you want to pierce the bone, pass a wire through that, that is used for a bone (( )) and then we have double edged knife, sharp hook again Madisha, dental scalar and probes of different kinds. There are very many different types of esyanies or probes. Now, these are the classical blunt and sharp instruments. We have illustrated some of them, just to give you an idea of the kind of instrumentation that was available to the surgeons in the remote past.

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Now, this will not do; so, great many others which are called Anusastras, but they are really not instruments, but they were necessary for the surgeons for his surgical procedure. Now, here you have bamboo strips, glass, rock, crystals, finger nails and most important Susruta points out in these, the surgeon's fingers; they are the most important according to him and alkali, leeches, cautery, sprouts, finger and here you can see the functions of that. When children are fearful of knife, that is when you would use bamboo strips or glass etcetera. Alkali, leeches, cautery; we have had a full discussion

of that. And for exploration, when the probes are not available, you have to use your finger.

Now, it is important here. The surgical instruments, we have simply listed all these. As some of you will know, Shakespeare said there are sermons in stone; stones are talking to us. Now, similarly, these surgical instruments, apart from their utility, they are also telling us something about the status of technology, about the status of surgery, all that has it existed in the remote past. Now, that is an important issue which is very much like the sermons stone talking to us giving us a sermon.

So, here these instruments are also telling us something much wider, much greater significance. So, I thought I should spend a little time on this unusual subject because the design and development of such a wide range of instruments for precision use in surgery would hardly be possible in the absence of metallurgy and metal craft of a very high order; that is very obvious.

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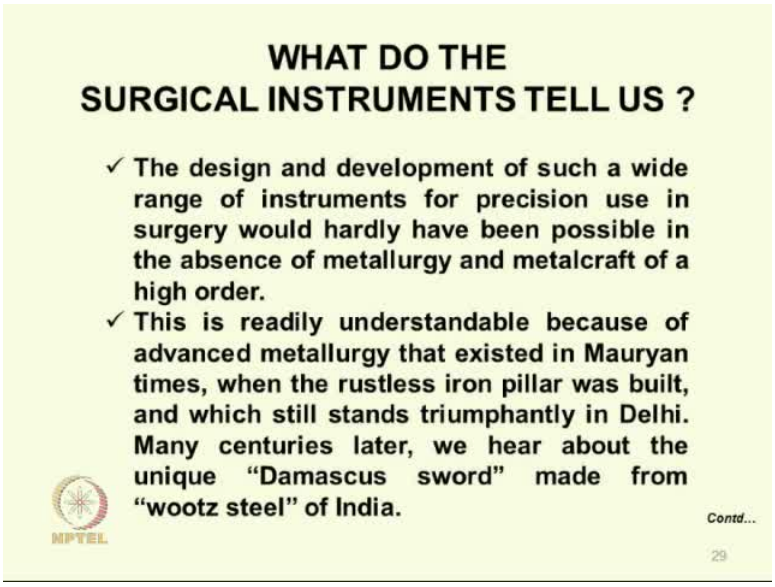

Now, this is not difficult to understand because advanced metallurgy existed. We all know that in Mauryan times, they had this Mauryan columns made. There is one Ashoka pillar standing in Delhi even today rustless; it has no rust; it has got a polish; it was made at that time. So, the metallurgy of a very high order existed at that time. That is understandable enough. Much later, many centuries later, we also hear of a Damascus sword; that is not the same thing as the Mauryan iron or steel. It was a different kind of

steel which was westerners called it the Wootz steel. How that name came? We are not very sure.

Now, this Damascus sword which was so famous, that was made of the Wootz steel which was made in India; in many parts of India. Now, this was always of great interest to the western countries. When the East India Company came to India, this was one of the things they wanted to investigate. How did the Indians make this steel? Now, the Susruta's instrument you saw, he himself says, it should be made of good quality iron.

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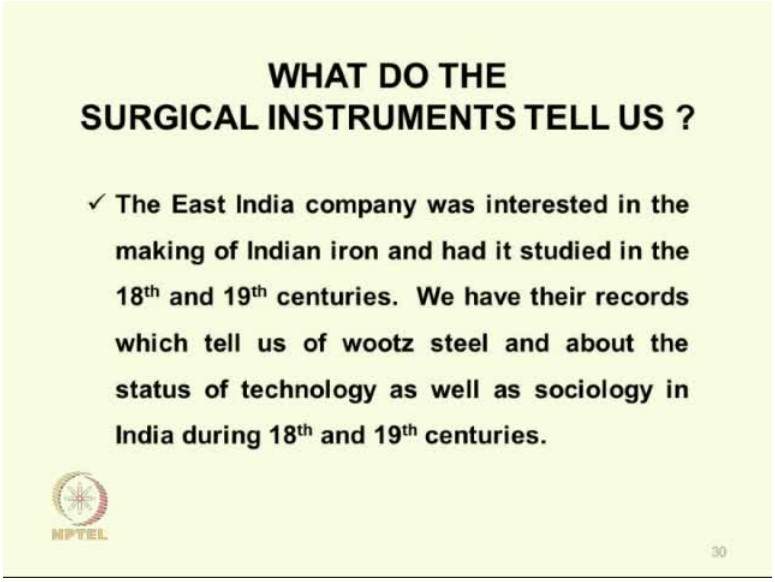

That was the Mauryan type, most likely because the time corresponds to that, but when it came to many centuries later again, that technology existed in India or something similar to that. And that is where we have some very clear records available of the 18th and 19th centuries, when a great many British observers came to India, they observed how the Indians were making the steel and that is of great interest to us because that may be something of the kind which was used in making the original instruments of Susruta.

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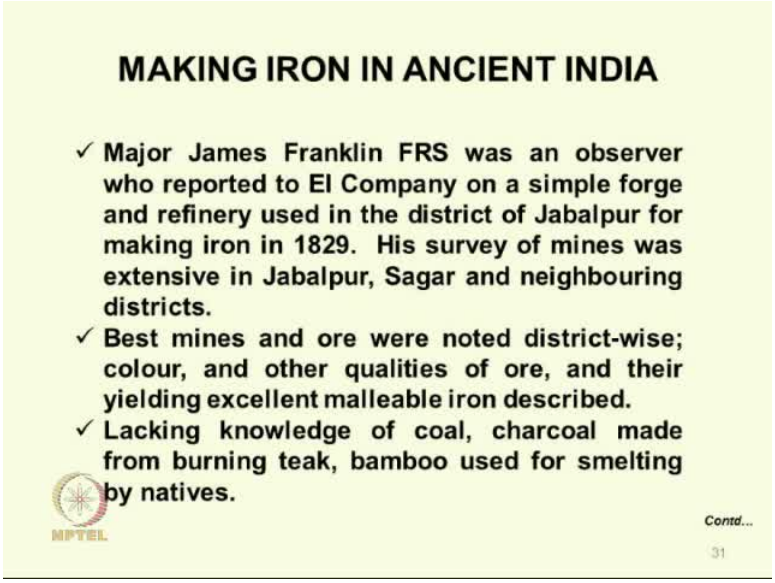

Now, Major James Franklin, he was a fellow of the Royal Society. He was an observer employed by the East India Company in Kolkata. He was sent to areas in Jabalpur, Jabalpur district, where this steel was being made and he was sent there to investigate how the Indians are making this steel. Now, when he went there, he stayed and observed all the practices very carefully, made careful documentation including diagrams, and these were sent to the Britain which are available; they are published.

Now, there he says, in 1829, he made this report and all the mines in that area he made an extensive survey and he identified the best mines which were being used; the kind of ores that existed there; ore which existed in other areas; the color, the quality of the ore and their yielding excellent malleable iron which was being made there by these local people. And lacking the knowledge of coal, there was no coal available; they were using charcoal from burning teak and bamboo for smelting purposes. This is what was being done as he observed.

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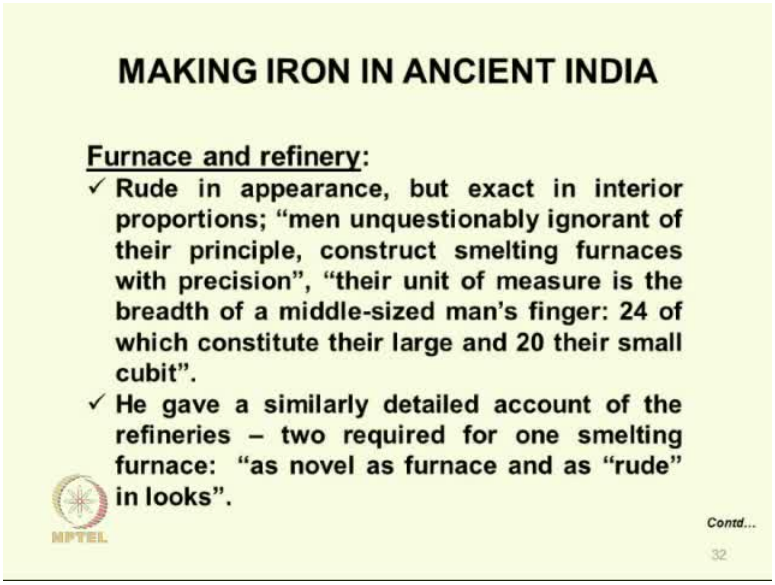

And they had two major equipments: one was the furnace; the other was a refinery. And furnace itself looked very rude in appearance; not at all impressive, but the interior dimensions were very exact. And the men who were working on this, they unquestionably to quote, unquestionably ignorant of their principle, they construct smelting furnaces with great precision.

Their unit of measure is the breadth of the middle sized man's finger, angula again, 24 of which constitute a large and 20 their small cubit. This was the measure they were using. Now, the interior dimensions measured accordingly, they were always exact. Now, he gave a similarly detailed account of the refineries; two refineries were required for one furnace; that was the practice.

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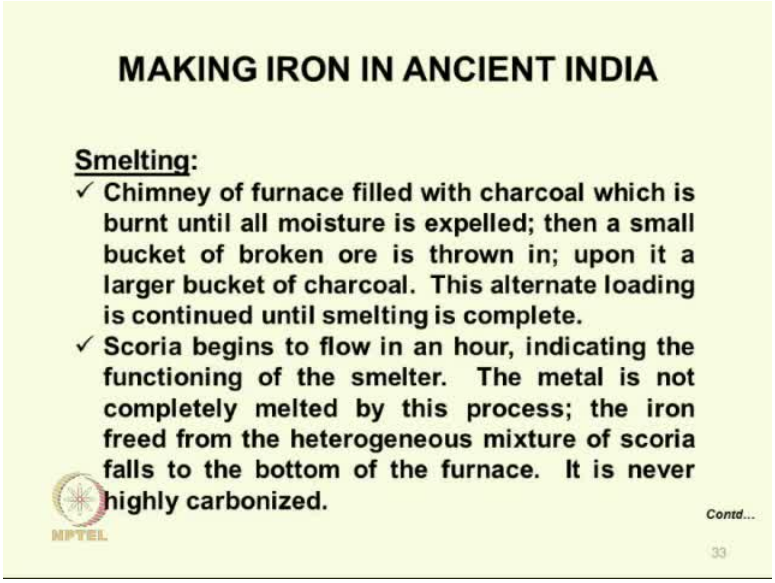

Now, this smelting itself here he describes the procedure they followed. A chimney of this furnace was constructed; rude outside, but exact interior. They were filled with charcoal which is burnt and prepared from bamboo or teak, and then a small bucket of broken ore would be put inside; then again it would be charcoal. So, alternately the charcoal and this ore, that would be packed and then it would be lit, and the scoria will start pouring out within an hour. That is what he writes there indicating the functioning of the smelter. The metal was not completely melted by this purpose, but towards the end of this, the iron which was freed from this scoria, that would deposit at the bottom of the furnace. It is never highly carbonized which he had examined.

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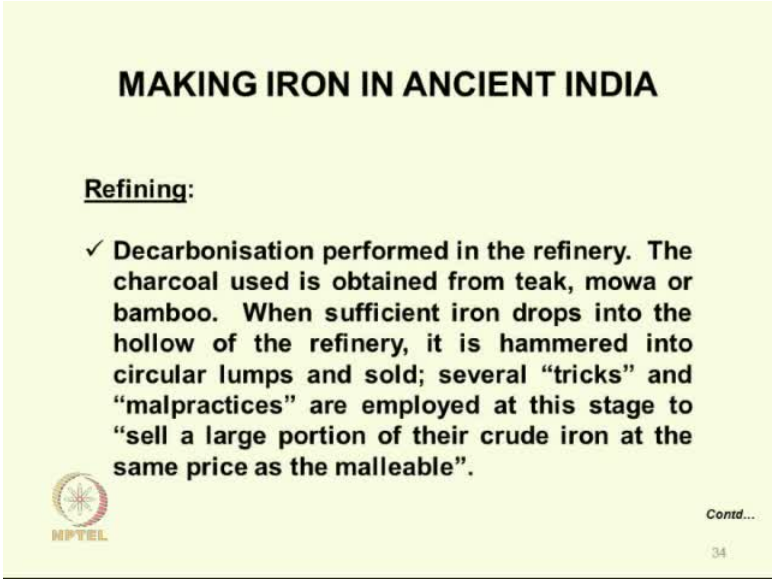

Decarbonisation: It moves next to the refinery. There are two refineries: for one furnace and the charcoal used obtaining from teak or bamboo, again for this purpose. And when it is sufficient, the iron drops into the bottom of this refinery; it is decarbonized. Now, this decarbonized iron is hammered; that is how its quality is improved and he has noted that in hammering. If they do not do it sufficiently, to save their own labor, they could even pass off inferior quality claiming as to be malleable iron. There is a malpractice even in those days, but he says, once it is properly ironed, it becomes high quality valuable iron.

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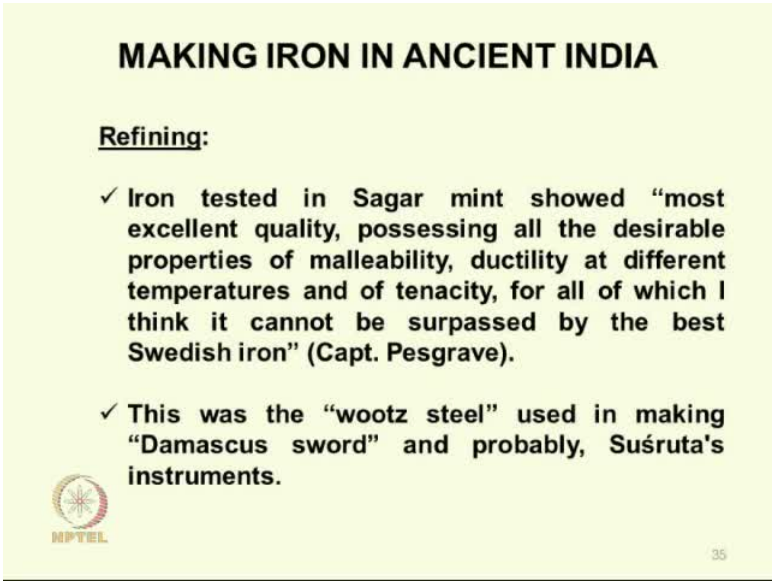

Now, this iron was tested in Sagar mint. There was a mint run by the East India Company and see the report of that Sagar mint of this iron which was made most excellent quality, possessing all the desirable properties of malleability, ductility at different temperature, and of tenacity and all of which I cannot, it cannot be surpassed by the best Swedish iron; that is the certificate given by Colonel Pesgrave.

This was the Wootz steel used in making Damascus sword and probably Susruta's instruments. We are not very sure that is speculative because Wootz steel came much later; Susruta's time it is possible Mauryan iron was used. We are not very sure, but anyway, the whole point is to make this kind of high precision instruments. With whole range of them we have seen, they could have been possible without high quality metal.

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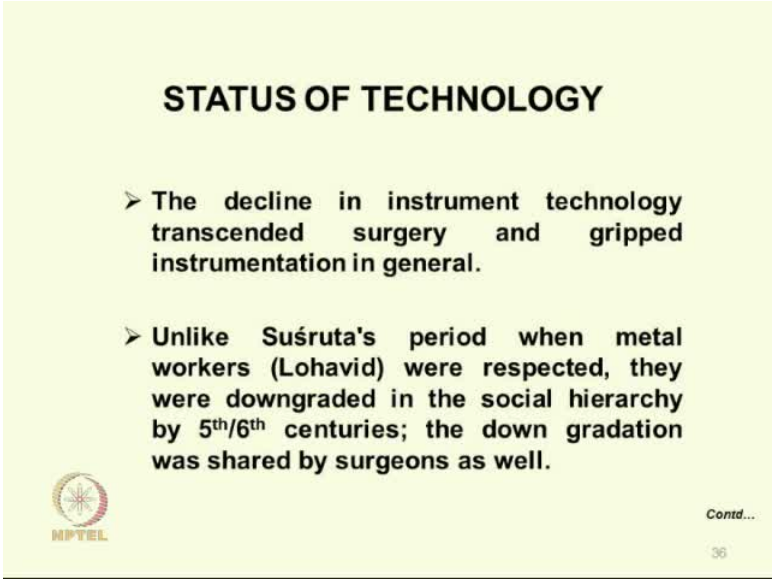

Now, the status of technology: The important first point here what we have to remember, this whole instrumentation technology which existed. By the time, early part of the say 3rd or 4th century, this whole technology practically disappeared because along there was a something a great set back at that time; we will be coming to that again when we discuss surgery. Both surgery as well as surgical instrumentation industry, they seem to have declined very considerably over a period of time. Certainly, by the 5th century, all these have practically come to a stop.

This is a great mystery; there is no adequate explanation for this, but this decline, it transcended instrumentation technology in general. Whether it is a surgical instrumentation or whether it is surgery, in all these, there is a certain decline. And unlike Susruta's period when metal workers were highly respected, they were called Lohavid; they were honored; whereas, these people were downgraded by fifth or sixth century; the people who were making steel for example.

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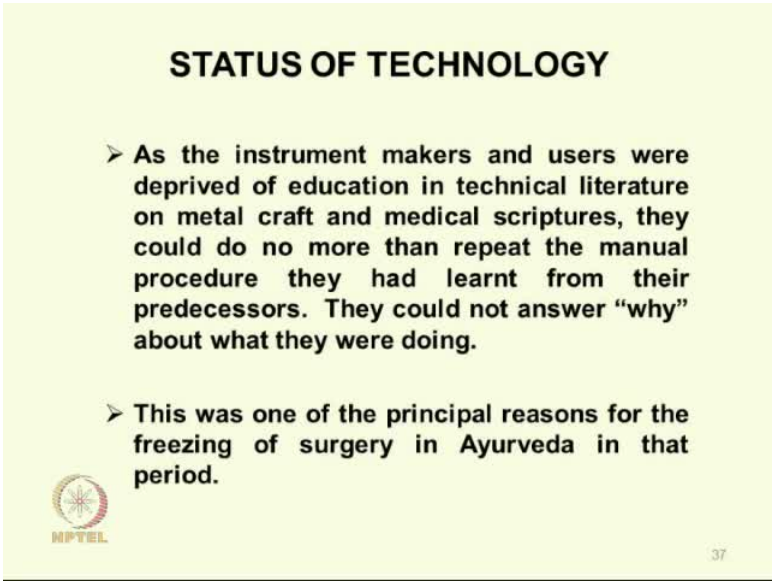

When James Franklin was asking these metal workers, why are you making it like this? Why do you have to have this billows attached at this angle? Why cannot it be done differently? And he would invariably get the reply that we do not know; this is how my father taught me; invariably they would get this reply. In other words, they were unable to answer the question, why it is done like this. They could do it perfectly. Certain amount of manual skill was there, but could not answer how. Now, that is what happened with these metal workers who gradually declined. And along with surgery, the metal craft to make these instruments that also virtually disappeared.

Now, these, as they were deprived of education, they were not capable of any innovation. That is what happens if the head, we will talk about it later also, the head and the hand, if they are not coordinated, what happens is manual skill may be there; they may be able to reproduce things exactly the same way, but they become incapable of innovation. This was one of the principal reason for the decline of surgery, the freezing of surgery, and the disappearance of surgical techniques from the mainstream of Ayurveda.

It moved out from the mainstream; then it survived in the hands of a small group of people; they were invariably labeled as low cast; they were practicing these techniques whether it was fracture reduction or couching for cataract; all these procedures. Now, that is an unfortunate part of India's history.

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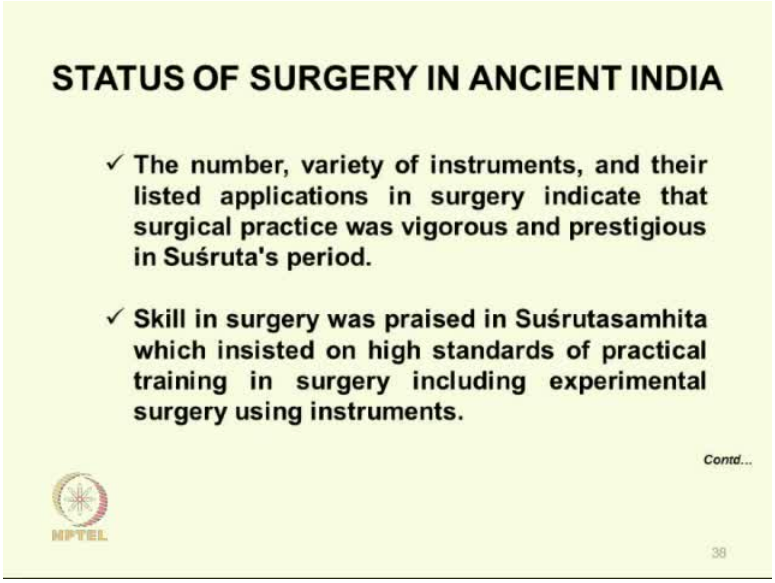

Now, say when you come to status of surgery in ancient India, again a similar story you will find. The number, the variety of instruments, and their listed applications indicate that surgical practice was vigorous and prestigious in Susruta's period. There is no question about that; it was given the top position shalya, which we have seen and this was practiced in Susruta Samhita which insisted on very high standard of training, experimental training, apprenticeship - all these are emphasized. These instruments were used in abundance with the, there are special sections Susruta says how important it is for a surgeon to be familiar, be completely at home in the use of these instruments.

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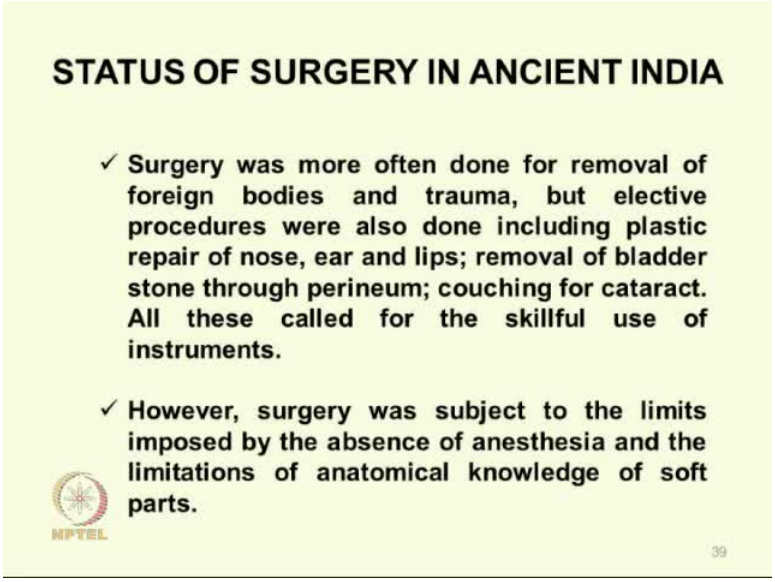

More often they are used were foreign bodies, trauma, but elective procedures were used for highly complicated operations like plastic repair of the nose, plastic repair of the ear, of lips, removal of bladder stone through the perineum, couching for cataract all these skills used very highly skillful use of instruments. But then, we must remember all these surgical procedures had two severe limitations; they were subject to these two.

And one was the lack of good knowledge of anatomy; that was defective; that we have to admit and second was the absence of anesthesia. So, subject to these two, there were great limitations in the practice of a surgery at that time. So, these two limitations plus the decline in the use of technology and the metal craft declined - all these put together that became the reason for the decline of surgery in Ayurveda.