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RESEARCH ARTICLE

COMPARATIVE STUDY OF LAMINECTOMY USING ULTRASOUND BONE SCALPEL AND CONVENTIONAL METHODS

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ABSTRACT

Introduction: The ultrasonic bone scalpel (UBS) is an ultrasonic device that cuts the bone without causing harm to the surrounding soft tissue and duramater. Such a type of selectivity of bone scalpel, particularly for bone destruction, makes the bone scalpel ideal for spine surgeries where there is the need to remove only bone adjacent to the duramater and neural structures, with the sparing of the duramater. Moreover, dural tear is the most common unintended complication of spinal surgeries nowadays. **Materials and Methods:** This is a prospective study of 100 patients operated for spinal decompression – cervical, thoracic, or lumbar – between January 2016 and June 2018 at BJ Medical College, Ahmedabad. **Aim:** To analyze the result of the use of UBS in spinal decompression over the conventional method of decompression, such as using the Kerrison Rongeur, high-speed burr drills, and conventional osteotome. **Observation and results:** Out of the 100 patients in our study, 48 patient had cervical, 14 patients had thoracic, and 38 patients had lumbar pathologies. There is significant reduction in duration of surgery and need for blood transfusion. We considered the Oswestry disability index (ODI) scores to measure the clinical outcomes of using bone scalpel and conventional methods at the end of 1 year. The scores were significantly improved with both methods. We had two case of dural tear out of 54 in a patients operated with conventional method. No dural tear noted in 46 patient operated with UBS. No neurological worsening in any patients was present. **Conclusion:** The UBS is a unique surgical device that reduces heat production and decreases the chances of dural tear, which makes it a suitable instrument for different spinal surgeries in recent days.

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INTRODUCTION

A laminectomy is a surgical procedure that removes a portion of vertebral bone called lamina, to decompress the cord or nerve root. Spinal stenosis is the most common indication of laminectomy. Dural tear is the most unintended complication during spinal surgeries nowadays. Management of Dural tears requires intraoperative surgical revision with or without fibrin glue or fat graft placement or post-operative flat bed rest with drain placement at adequate medication to reduce cerebro spinal fluid leakage. Despite this measure however complications following laminectomy procedures resulting from dural tears and infection may develop in terms of orthostatic headaches, wound necrosis, infection etc. With the routine methods of spinal decompression like osteotomes, nibblers, high speed drills and diamond burrs

there is increased incidence of dural injuries due to thin dura and harder bone. Use of high-speed drills and diamond burrs may increase the heat production and cause damage to soft tissue. Moreover, the vibration produced by high speed drills (HSDs) may cause fatigue to surgeons and produce discomfort. ULTRASOUND BONE SCALPEL (UBS) in spinal surgeries especially for laminectomy is increasing in popularity due to numerous potential advantages, including reduced length of stay, blood loss, reduced time of surgery and very less chances of complications like dura tear.

MATERIALS AND METHODS

It is a prospective study of 100 patients operated for spinal decompression – lumbar, cervical, or thoracic and combine - between January-2016 to January-2018, using either through conventional method or ultrasound bone scalpel at B.J Medical college, Ahmedabad. Patients` demographics profile, disease type, duration of surgery,

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blood loss (measured by weighting gauze piece and measuring drain output during surgery), hospitalization, complications, peri-operative and follow-up Oswestry disability score (ODI), Visual Analogue Scale (VAS).

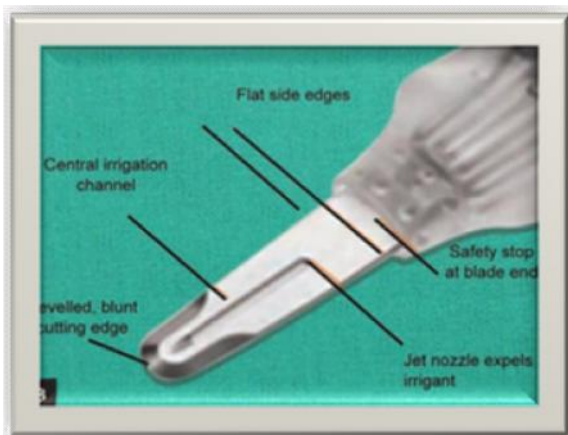
TECHNICAL ASPECTS OF UBS

Principle of UBS: It acts by back- and- forth micromotion of the cutting blade at around 22,500 times per second. And the ultrasonic cutting blade comes in to contact with bone .it does not bend but transfers the large amount of energy to that point of bone and cuts the bone. however, when it comes into contact with soft tissue like dura matter or ligamentum flavum such soft tissue can bend and move away from the tip of cutting blade hence the ultrasonic blade is not able to transfer a high energy to that part of tissue and, thereby, causes no damage to the soft tissue. Angled blade is also available which is used mainly in lumbar region where we perform multiple level decompression.

The UBS device includes 3 parts

-) Ultrasonic generator
-) Irrigation pipe
-) Cutting blade

The irrigation pipe and cutting blade together along with the hand piece connect to the ultrasonic generator device.



Observation and analysis: In this study, 100 patients were included. 46 were operated for laminectomy Using ultrasound bone scalpel (UBS) and 54 patients operated using conventional method like high speed drills and were followed for average 6 months for total follow up of at least 1 year longest follow up of patient is 24 months and shortest is 14 months. So average follow up duration is 19 months We have following observation and results according to. Maximum numbers of patients were found in age group of 51-60 (42%). Mean age of our study is 50.85 years. In this study, total 52% are male and 48% are female. So male to female ratio is almost 1:1. Average blood loss during surgery using conventional methods was 300 ml and with UBS was 90 ml. Maximum number of patient operated for laminectomy in our study is having cervical pathology (48%), followed by lumbar level (38%). The duration of the operation is around 90 to 120 minutes in thoracic, 60 to 75 minutes in lumbar, and 45 to 60 minutes in cervical decompression.

Table 1. Number of Patients According To Age Incidence

Age	Number of patients		
	Conventional Method	UBS	Total
21-30	03	02	05
31-40	07	08	15
41-50	16	12	28
51-60	22	20	42
61-70	06	04	10
TOTAL	54	46	100

Table 2. Comparison of result of conventional method and ubs according various parameter

Surgery	Avg. blood in ml	Duration (min)	Infection rate	Dura tear rate	Duration of hospitalization (days)
Conventional method	120	120 min	1%	3%	3
Ultrasound bone scalpel	90	90 min	0%	0%	5-6

Table 3. number of patients according to level of spinal canal stenosis

Level	Conventional Method	Ubs	Total
CERVICAL	26	22	48
DORSAL	8	6	14
LUMBER	20	18	38
TOTAL	54	46	100

Table 4. Comparison of result of conventional method and ubs according to odi score

RESULT	CONVENTIONAL METHOD	UBS
EXCELLENT	10	12
GOOD	25	24
FAIR	13	8
POOR	6	2
TOTAL	54	46

The mean preoperative ODI score in the lumbar was 40% and in the thoracic was 50%. At, follow up, 1 year after surgery, the ODI score dropped to 20% in lumbar pathology and to 30% in thoracic pathology .The blood loss during surgery is minimal in cervical decompression (250ml) and maximal in dorsal spinal decompression (500 ml). The hospital stay is quite reduced in comparison to the conventional method from 4 to 8 days to 2 to 3 days. Complications, such as neurology worsening, infection, and morbidity were not seen in any case except two dural tears in lumbar decompression.

DISCUSSION

As mentioned earlier, complications, such as blood loss, dural tear, and thermal trauma are less when UBS is used.

Average duration of surgery is reduced as observed in our study. Moreover, with UBS, the bone can be cut with better control and precision. The UBS also has the advantage of its short learning curve compared with burr/drill and reduced fatigue to the surgeon.^{3,4} Bydon et al² described 5.7% complication rate of incidental durotomy while performing laminectomy by using UBS, which is similar to the incidence of incidental durotomy found in our study, which is 5%.^{2,9} Oner et al, in their study, found average blood loss during cervical laminectomy to be 380 mL with HSD as compared with 180 mL with UBS. Average blood loss in our study for cervical laminectomy was found to be 250 mL, which

supports the finding that UBS causes lower blood loss compared with HSD.¹⁰ There are very few studies regarding comparison between UBS and other methods of cutting bone. Longterm studies regarding outcomes and side effect(s) need to be considered. The horizon of UBS can also be extended in orthopedic surgeries that require precise bone cutting like hemireplacement arthroplasty. By routine use of UBS, there is reduced blood loss and one can harvest intact bone bloc, which can be used as bone graft, thereby reducing the need for bone substitutes like bone morphogenic protein and bone stimulators. Due to lower blood loss, the rate of blood transfusion is also reduced. The UBS, being costly, has a questionable affordability in an individual setup, but is cost-effective when used in government hospitals. It is specifically beneficial to our society in tertiary health centers, where there is a huge patient load. Moreover, there is higher incidence of fluorosis, ossified yellow ligament, multiple-level pelvic inflammatory disease, and corpectomy. Due to various advantages of bone scalpel, such as less duration, decreased blood loss, less fatigue of surgeon, higher number of patients can be operated, we can reduce patients' load and maximum number of patients can benefit from it. Most importantly, the reduced risk of CSF leak and neurological injury provide significant economic benefits, such as reduced use of expensive bony substitutes and number of blood transfusions; additionally, it reduces the duration of hospitalization, rates of readmission, and other complications.

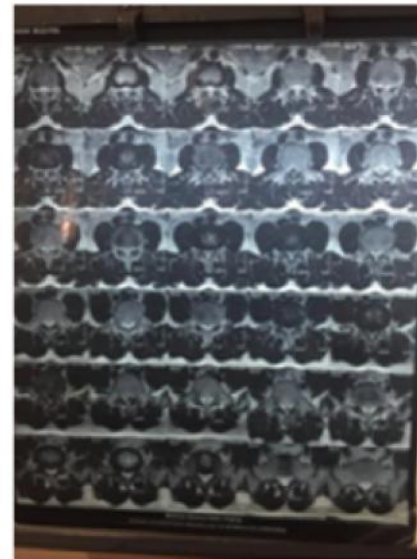
Conclusion

Bonescalpel is an effective ultrasonic device that becomes an essential component in spine surgeries where there is a risk of dural injury. It is superior to power drills and diamond burrs for bone cutting in various spinal surgeries. The judicious use of this device requires a tactile feel for bone when it is penetrated. The limitation is its cost in individual setups, but once the tactile feel and en bloc bone elevation techniques have been mastered, spinal decompression can be performed with more safety and efficiency.

CASE REPORT

A 23 year old male patient, having complain of lower back pain with bilateral lower limb radicular pain more on left side since six months. Patients neurology was normal. There was no any past history of trauma or fall or any constitutional symptoms. Patient was previously treated with analgesics and physiotherapy.

Preop Mri



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