

**A CLINICAL COMPARISON OF BUPIVACAINE VERSUS LIDOCAINE FOR  
MAXILLARY AND MANDIBULAR ANESTHESIA IN ORAL SURGERY**

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**ABSTRACT:**

**Background:** The purpose of this study was to compare the efficacy of bupivacaine and lignocaine for the surgical removal of mandibular impacted third molars. The study focused on pain experience and analgesic consumption.

**Materials and Methods:** Forty patients, aged between 18-45yrs, were selected each with bilateral mandibular third molar indicated for extraction under local anesthesia. The mean age of the patients was 24 years and the ratio of males to females was 23 to 17. All patients randomly received lignocaine 2% with adrenaline 1:200,000 for one extraction and bupivacaine 0.5% with adrenaline 1:200,000 for the other sided extraction.

**Results:** The visual analog and global pain scores for both groups were outlined. There was no significant difference between bupivacaine and lidocaine for intra-operative pain experience.

**Conclusion:** There were no signs or symptoms of central nervous system or cardiovascular system toxicity in this study and the routine use of bupivacaine in oral surgery would appear to

be a safe and effective method of producing adequate surgical analgesia and an increased post-operative pain free period.

**KEYWORDS-** Bupivacaine, Impacted third molars, Lignocaine, Visual analog scale, Global pain scale.

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## **INTRODUCTION:**

The eruption time of third molars is generally between 18 to 24 years of age. However, a wide variation in the eruption time is common making eruption failure very common with the tooth impacted variously in the jaw. This makes the extraction of impacted third molars one of the most frequently carried out surgical procedure and most common oral surgical procedure.<sup>1, 2</sup>The surgical removal of third molars is a procedure generally followed by side effects such as postoperative pain, swelling, and trismus<sup>3, 4,5,6,7</sup>Post-operative pain is the most common complication after tooth extraction and is also the most common complication in oral surgery<sup>8, 9,</sup><sup>10</sup>According to literature, pain after surgical extraction of a third molar reaches its highest intensity 6-8 hours after surgery<sup>11, 12</sup>Stanley F. Malamed has defined local anesthesia as “a loss of sensation in a circumscribed area of the body caused by a depression of excitation in nerve endings or an inhibition of the conduction process in peripheral nerves.”<sup>14</sup> Lidocaine 2% with adrenaline 1:200,000 (Xylocaine) is regarded as the golden standard for local anesthesia in India to which other agents are compared. It is also the most commonly used in India.

Bupivacaine 0.5% with adrenaline 1:200,000 (Marcaine) has increasingly become popular within surgical circles worldwide given its longer duration of action and post-operative analgesia and anesthesia. Bupivacaine is four times as potent as lidocaine at equivalent doses<sup>14, 15</sup>. On this basis, 0.5% bupivacaine should be equally as effective as 2% lidocaine. Since bupivacaine is also approximately four times as toxic as lidocaine, their toxicities at these concentrations should be equal at equivalent doses.<sup>15</sup> The times of onset of anesthesia and establishment of maximum anesthesia compare favorably to those for lidocaine, but bupivacaine produces up to three times the duration of anesthesia.<sup>15, 16, 17</sup>Laskin et al. reported that bupivacaine can be used clinically

with less concentration of vasoconstrictor than lidocaine, or indeed without a vasoconstrictor. In their study, there was little clinical difference when 0.25% bupivacaine without epinephrine was compared to 2% lidocaine with 1:000,000 epinephrine.<sup>1</sup>

## **MATERIALS AND METHODS**

From January 2012 to October 2013, forty patients diagnosed with bilateral mandibular third molars indicated for extraction were included in the study. This study was conducted at M.A.Rangoonwala Dental College & Research Centre, Pune and approved by the Research Ethics Committee with written informed consent obtained from all patients.

### **STUDY DESIGN:**

Forty patients, aged between 18-45yrs, were selected each with bilateral mandibular third molar indicated for extraction under local anesthesia. All patients randomly received lignocaine 2% with adrenaline 1:200,000 for one extraction and bupivacaine 0.5% with adrenaline 1:200,000 for the other sided extraction. The site of extraction as well as choice of anesthetic to be administered was selected randomly immediately before the procedure by the operator. Both surgical procedures were spaced out at an average 4 week gap between them. A safe anesthetic technique was used with a standardized amount of anesthetic, previous aspiration and as atraumatic extraction as possible was carried out.

For surgical removal of a mandibular third molar, a total of 2 ml of local anesthetic was administered as a standard inferior alveolar nerve block, 0.5 ml as a lingual nerve block and further 0.5 ml as infiltration for the long buccal nerve, making the total local anesthetic administered at 3ml. The 3 ml solution contained 60 mg of lignocaine and 0.015 mg adrenaline; and 15 mg bupivacaine and 0.015 mg adrenaline respectively. All surgical procedures were begun 10 minutes after local anesthetic administration. Anesthesia was deemed to be unsuccessful if pain was experienced by the patient when a sharp probe was applied to the mucosal surface. Local anesthetic was then re-administered and 5 minutes allowed passing before commencement of the procedure. If after a further 5 minutes anesthesia was still

unsatisfactory, an additional cartridge of local anesthetic was given but the subject was excluded from the trial.

A standardized surgical technique was used for all subjects. The procedure for mandibular third molars involved a Ward's incision, buccal and lingual periosteal flaps, bone removal and bone division with a bur. All wounds were closed with 3-0 silk interrupted sutures. The time from commencement to completion of surgery was recorded.

All patients received a pain assessment form at the completion of surgery. Each patient was asked to record their intra-operative pain experience as well as their post-operative pain experience at 4, 8, 12, 16 hours. Pain experience was assessed by 2 methods:

1. Visual Analog Scale – Each subject indicated the degree of pain experience on a plain, horizontal 10 cm visual analog pain scale with “no pain” at 0 cm, “mild pain” at 1-3 cm, “moderate pain” at 4-6 cm, “severe pain” at 7-9 cm and “worst pain imaginable” at 10 cm.
2. Global Scale- Subjects were asked to indicate the appropriate response from one of the following pain categories, 0-“none”, 1-“a little”, 2-“some”, 3-“a lot” or 4-“worst possible”.

The patients were discharged with a 5 day course of Amoxicillin (500 mg) (or Erythromycin in cases of allergy) and Diclofenac Sodium (50 mg) and Paracetamol (500 mg) combination (Diclomol™) given thrice a day. No post-operative sedation was used.

## **RESULTS:**

The mean age of the patients was 24 years and the ratio of males to females was 23 to 17.

### **Anesthetic Volume:**

The difference in the mean volume of local anesthetic used was not statistically significant.

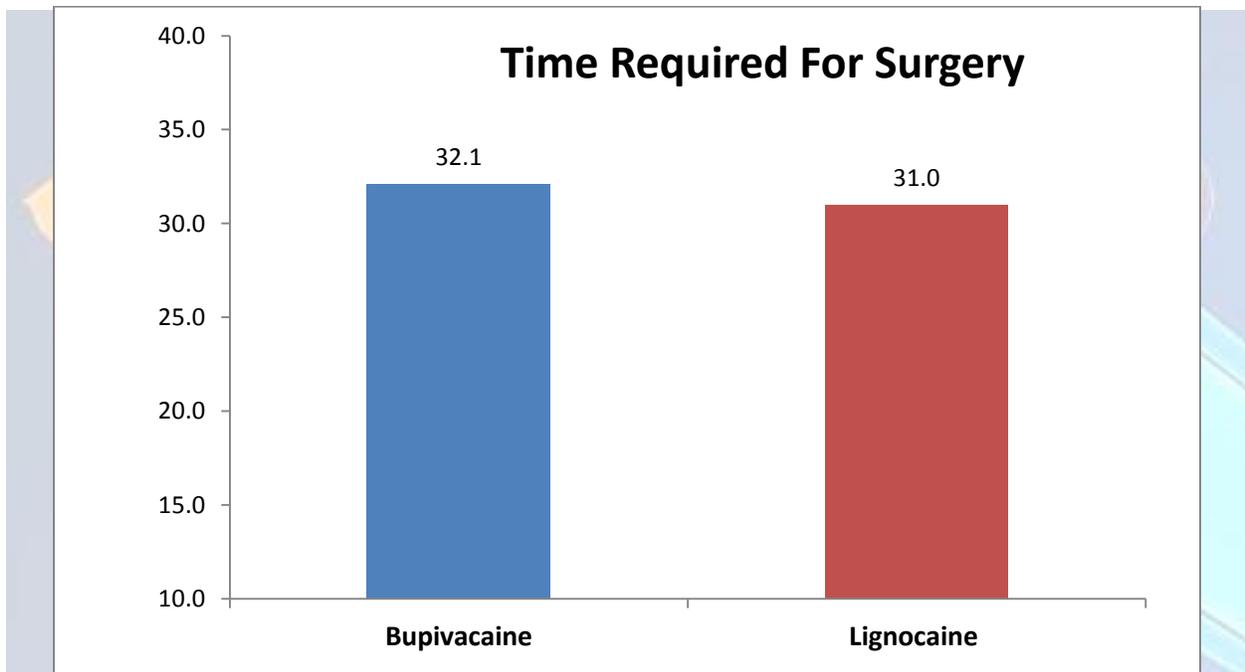
### **Surgical Time:**

The times taken for the surgical procedures with both bupivacaine and lignocaine are shown in table 1. The range of times taken for the surgical procedure with bupivacaine was 23 to 40

minutes while the range with lidocaine was 21 to 40 minutes. The difference was not statistically significant (Graph 1).

<b>Time required (mins)</b>	<b>Bupivacaine (n=40)</b>	<b>Lidocaine (n=40)</b>	<b>P-value (Inter-Group)</b>
Mean ± StdDev	32.1 ± 4.5	31.0 ± 5.6	0.490 (Non-Significant)

Values are Median (Min – Max). P-values are obtained using Mann-Whitney U test (Non-parametric un-paired analysis). P-value<0.05 is considered to be statistically significant.



Graph 1.

**Visual Analog and Global Pain Scores:**

The visual analog and global pain scores for both groups are outlined below. There was no significant difference between bupivacaine and lidocaine for intra-operative pain experience. In all patients, the depth of anesthesia was adequate for completion of surgery.

Table 1a. Showing intra-group comparison of VAS for pain:-

<b>VAS</b>	<b>Bupivacaine (n=40)</b>	<b>Lignocaine (n=40)</b>
Intra-op	1 (0 – 6)	1 (0 – 6)
4-Hrs Post-op	2 (0 – 7)	3 (1 – 10)
8-Hrs Post-op	1 (0 – 5)	3 (0 – 7)
12-Hrs Post-op	1.5 (0 – 4)	2 (0 – 6)
16-Hrs Post-op	2 (0 – 7)	2 (0 – 7)
<b>P-values (Intra-Group)</b>		
Intra-op v/s 4Hrs Post-op	0.004 (Significant)	0.001 (Significant)
Intra-op v/s 8Hrs Post-op	0.753 (Non-Significant)	0.001 (Significant)
Intra-op v/s 12Hrs Post-op	0.344 (Non-Significant)	0.321 (Non-Significant)
Intra-op v/s 16Hrs Post-op	0.134 (Non-Significant)	0.798 (Non-Significant)

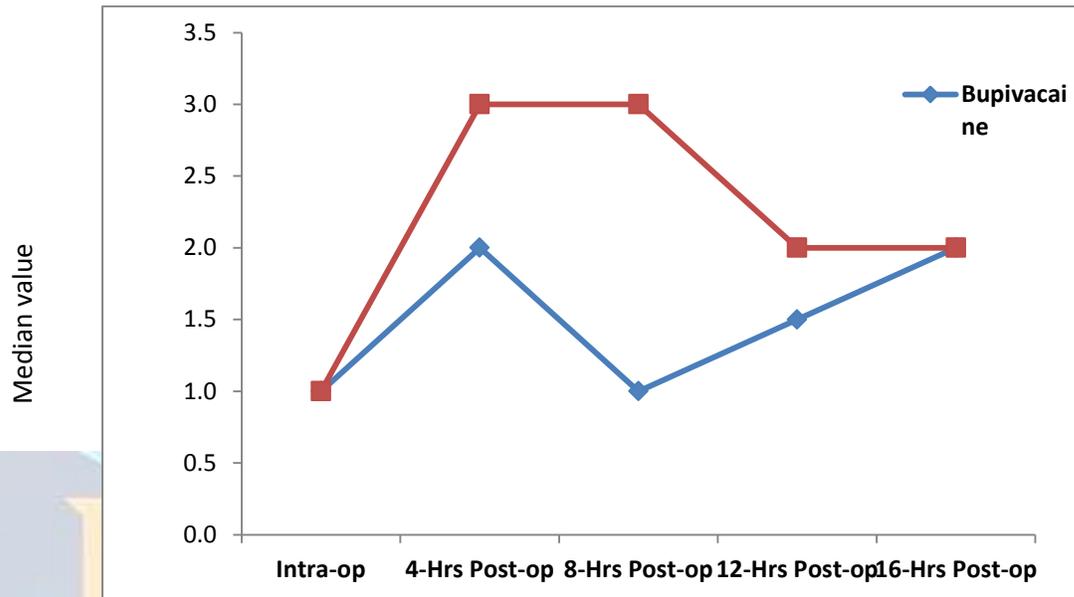
Values are Median (Min – Max). P-values are obtained using Wilcoxon’s signed rank test (Non-parametric paired analysis). P-value<0.05 is considered to be statistically significant.

**Table 1b) The inter-group comparison of VAS for pain.**

<b>VAS</b>	<b>Bupivacaine (n=40)</b>	<b>Lignocaine (n=40)</b>	<b>P-value (Inter-Group)</b>
Intra-op	1 (0 – 6)	1 (0 – 6)	0.960 (Non-Significant)
4-Hrs Post-op	2 (0 – 7)	3 (1 – 10)	0.001 (Significant)
8-Hrs Post-op	1 (0 – 5)	3 (0 – 7)	0.001 (Significant)
12-Hrs Post-op	1.5 (0 – 4)	2 (0 – 6)	0.353 (Non-Significant)
16-Hrs Post-op	2 (0 – 7)	2 (0 – 7)	0.607 (Non-Significant)

Values are Median (Min – Max). P-values are obtained using Mann-Whitney U test (Non-parametric un-paired analysis). P-value<0.05 is considered to be statistically significant.

**Graph 2) The distribution of VAS between two study groups.**

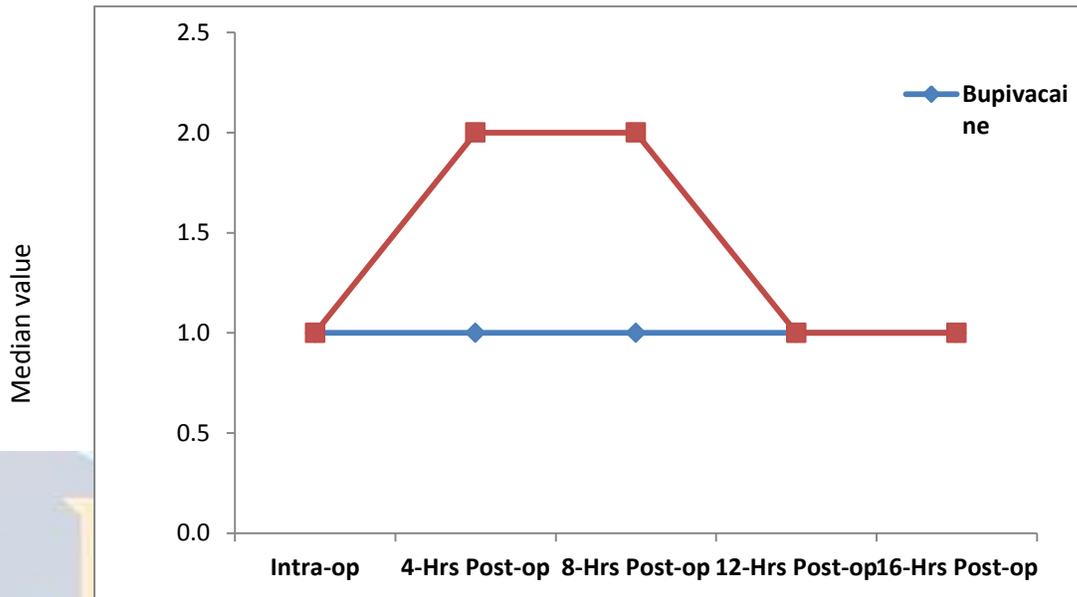


**Table 2a) The intra-group comparison of Global pain score.**

Global pain score	Bupivacaine (n=40)	Lignocaine (n=40)
Intra-op	1 (0 – 3)	1 (0 – 3)
4-Hrs Post-op	1 (0 – 3)	2 (1 – 4)
8-Hrs Post-op	1 (0 – 2)	2 (0 – 3)
12-Hrs Post-op	1 (0 – 3)	1 (0 – 6)
16-Hrs Post-op	1 (0 – 3)	1 (0 – 3)
<b>P-values (Intra-Group)</b>		
Intra-op v/s 4Hrs Post-op	0.068 (Non-Significant)	0.001 (Significant)
Intra-op v/s 8Hrs Post-op	0.184 (Non-Significant)	0.002 (Significant)
Intra-op v/s 12Hrs Post-op	0.068 (Non-Significant)	0.053 (Non-Significant)
Intra-op v/s 16Hrs Post-op	0.141 (Non-Significant)	0.720 (Non-Significant)

Values are Median (Min – Max). P-values are obtained using Wilcoxon’s signed rank test (Non-parametric paired analysis). P-value<0.05 is considered to be statistically significant.

**Graph 3) The distribution of Global pain score between two study groups.**



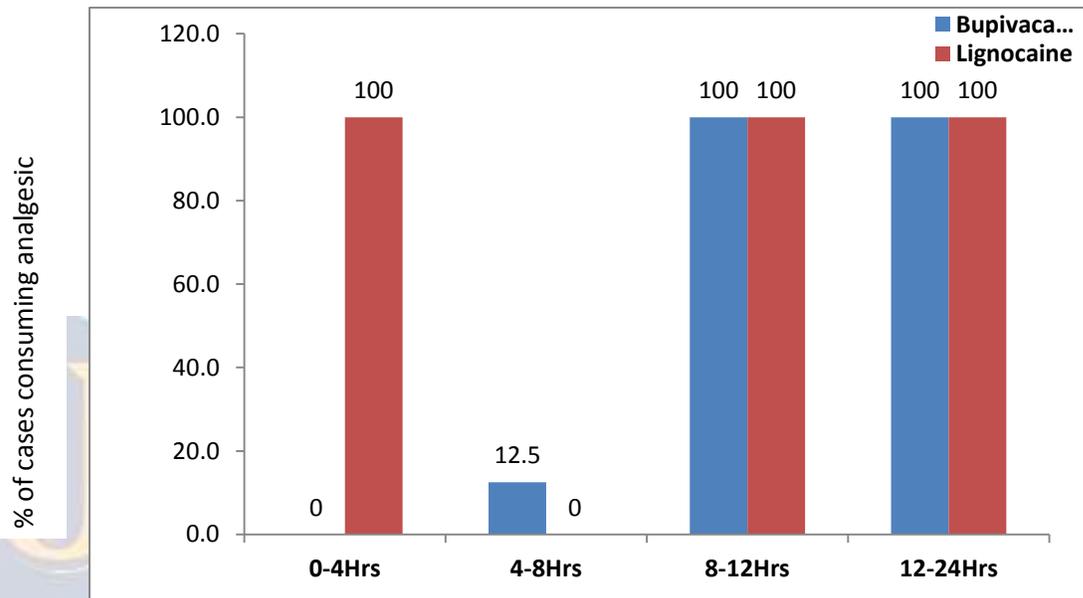
**Analgesic Consumption:**

The analgesic consumptions at various post-operative time periods are outlined below. **Table 3a) The intra-group comparison of Analgesic consumption.**

Analgesic consumption		Bupivacaine (n=40)	Lignocaine (n=40)
0 – 4Hrs	Nil	40 (100.0)	0
	One	0	40 (100.0)
4 – 8Hrs	Nil	35 (87.5)	40 (100.0)
	One	5 (12.5)	0
8 – 12Hrs	Nil	0	0
	One	40 (100.0)	40 (100.0)
12 – 24Hrs	Nil	0	0
	One	40 (100.0)	40 (100.0)
<b>P-values (Intra-Group)</b>			
0-4Hrs v/s 4-8Hrs		0.025 (Significant)	0.001 (Significant)
0-4Hrs v/s 8-12Hrs		0.001 (Significant)	0.999 (Non-Significant)
0-4Hrs v/s 12-24Hrs		0.001 (Significant)	0.999 (Non-Significant)

Values are n (% of cases). P-values are obtained using Chi-Square test (Fisher's Exact Probability test). P-value<0.05 is considered to be statistically significant.

**Graph 4) The distribution of Analgesic consumption between two study groups.**



## **DISCUSSION**

Pain is one of the most commonly experienced symptoms in dentistry. It is often spoken of as a protective mechanism since it is usually manifested when an environmental change occurs that causes injury to responsive tissues.<sup>18</sup> when an environmental change occurs that causes injury to responsive tissues. Local anesthetics when used for the management of pain differ from most other drugs commonly used in Medicine and Dentistry in one very important manner.<sup>19</sup> Virtually all other drugs, regardless of the route through which they are administered, must ultimately enter into the circulatory system in sufficiently high concentrations before they can begin to exert a clinical action.<sup>20</sup>

### **Local Anesthesia**

Local anesthesia is defined by Stanley Malamed as a loss of sensation in a circumscribed area of the body caused by a depression of excitation in nerve ending or an inhibition of the conduction

process in peripheral nerves. Local anesthesia is also defined by Daniel Laskin as a transient regional loss of sensation to a painful or potentially painful stimuli resulting from a reversible interruption of peripheral conduction along a specific neural pathway to its central integration and perception in the brain.<sup>16</sup>

## **LIDOCAINE**

Lignocaine (N-diethyl amino acetyl- 2,6- xylidide) was first synthesized by Lofgren, a Swedish Chemist in 1943 and was first introduced into clinical use in 1948. It has a molecular weight of 234.3 and its empirical formula is C<sub>14</sub>H<sub>22</sub>N<sub>2</sub>O.<sup>21</sup> As with all anesthetics, lignocaine has a common formula consisting of a lipophilic end, an intermediate chain and a hydrophilic end. Lignocaine base is a white crystalline powder and has a melting point of 66-69°C. The development of a sterile packaging system has enabled the manufacturer to exclude preservatives such as methylparaben, which have been implicated in allergic reaction to local anesthetics in a number of patients, as stated by Aldrete J. and Johnson D, 1970.<sup>22</sup> Lignocaine exists at physiological pH (7.4) predominantly in the ionized form (65%).<sup>23</sup> Covino (1986) has described the onset of anesthesia with lidocaine as rapid when compared to other local anesthetics.<sup>24</sup>

## **BUPIVACAINE**

Bupivacaine (1-butyl-2',6'-piperidoloxlidide) was first synthesized in 1957 by Ekenstam, a Scandinavian chemist and was first introduced into clinical use in 1963.<sup>21</sup> It is the longer side chain with 4 methylene groups on the piperidine ring that is responsible for the different properties of bupivacaine when compared to lidocaine. The base is not soluble in water, but the acid salt, bupivacaine hydrochloride C<sub>18</sub>H<sub>28</sub>N<sub>2</sub>O HCl is slightly soluble. It is the form of bupivacaine that is used for administration by injection.<sup>24</sup> Bupivacaine hydrochloride exists in solution as an equilibrium mixture of the non-ionized (free base) and the ionized (cationic) form, bupivacaine is considered to be 4 times as potent as lidocaine. Equipotent doses of both local anesthetics are achieved by variations in their concentrations, 0.5% and 2% respectively.<sup>25,26</sup> As with lidocaine, the absorption of bupivacaine proceeds in a biphasic manner with an initial peak

blood concentration occurring in 10-20 minutes after injection and a continued decline in blood concentration as the net absorption is exceeded by its distribution, metabolism and clearance.<sup>27</sup>

### **Distribution:**

Due to a small number of patients included in the study, it was not possible to provide an equal sex distribution among the subjects. The ratio of males to females was 23 to 17. The age range of the subjects was 18-45 years with a mean of 24.

### **Anesthetic Volume:**

The mean volume of bupivacaine solution used for each subject was 3 mL and the mean volume of lignocaine solution used was 3 mL. The difference in the mean volume of local anesthetics used was not statistically significant which would suggest that 0.5% bupivacaine and 2% lignocaine are equipotent when used in similar volumes.

### **Surgical Time:**

All subjects had 2 impacted third molars surgically removed. Only those patients that had bilaterally symmetrical, impacted third molars were selected for the trial. The difference in the mean time taken for the surgical procedures with bupivacaine and lignocaine was not statistically significant. The mean time for the bupivacaine procedure was 32.05 minutes while that for lignocaine procedures was 31minutes.

### **Visual Analog and Global Pain Scores:**

A visual analog and five point global pain score was recorded by each subject at the completion of surgery. This was supervised by the author to ensure that each subject was completely familiar with both scales and therefore, would be able to record pain scores at home in the post-operative period. Subsequent pain scores were recorded by the subject at 4 hourly intervals for 16 hours. It is possible that the use of small volumes of local anesthetic in these studies may favor bupivacaine with its greater potency due to increased lipid solubility and protein binding capacity.

### **Analgesic Consumption:**

Each subject recorded the number of analgesics and the time consumed, from completion of surgery until no further medication was required. The analgesics were provided by the principal investigator at the completion of surgery at the same time as the antibiotics. The analgesic chosen for this trial was a combination of Diclofenac Sodium (50 mg) and Paracetamol (500 mg) called Diclomol™. For the purpose of statistical analysis, the analgesics consumed were grouped into six post-operative time frames: 0-4 hours, 4-8 hours, 8-12 hours, 12-16 hours and total analgesics consumed. It was felt that the total number of analgesics consumed should be used for analysis in order to determine whether the choice of local anesthetic agent influenced the total number of analgesics consumed.

### **CONCLUSION:**

The purpose of this study was to compare the efficacy of bupivacaine and lignocaine for the surgical removal of mandibular impacted third molars. The study focused on pain experience and analgesic consumption. Visual analog and global pain scores were recorded in the post-operative period at 4, 8, 12, 16 hours. Bupivacaine and lignocaine were both found to produce adequate analgesia for the completion of all surgical procedures. As was found in this study, the reduction in pain experience with bupivacaine does not necessarily correlate with a reduction in analgesic consumption. Bupivacaine is clearly of benefit to the patient in delaying the onset of pain, but based on the outcome of this study, some caution must be exercised in recommending its use to reduce analgesic requirements

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