Study of Nature of Glove Puncture Injury and its Occurrence in Orthopaedic Surgery

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ABSTRACT

Background: *In orthopedic practice glove punctures are very common entity. Integrity of gloves act as a barrier in protecting the operating team from various blood related infections. Breach in this integrity of gloves make the operating team susceptible to patient's body fluid and hence increases the infection chances. In today's world due to presence of conditions such as HIV, Hepatitis B and C, our study is pointing out the infection rate and factors that can lead an operating team vulnerable to such infections.*

Material & Methods: *Gloves that were collected from respective orthopaedic procedures were subjected to the standardized water leak test. These gloves were evaluated for leakages and were compared to a control group of unused gloves from the same pack after each respective surgical procedure.*

Result: *The perforation rate of gloves was found to be 12.6 (240/1856) with operative perforation rate of 45%. The gloves of the surgeon got perforated at a rate of 21.4% (120/560). The perforation rate of index finger and thumb were the found to be 57% and 22% respectively. The perforation rate of outer glove was 81.3% and the inner glove was 20.4%. Those surgeries lasting more than 100 minutes were related to a perforation rate of 67%.*

Conclusion: *Double gloving techniques are preferred to delineate the chances of glove perforation related infections and also encouraged for prolonged procedures which will eventually lead to the decreased chances of exposure.*

Key words: *Gloves; Puncture; Surgery*

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INTRODUCTION

Now a day, the surgeon is exposed to various blood borne infections due to the prevalence of viral and serological diseases such as HIV, Hepatitis B and C in the general population in India. The seroconversion risk due to needle prick during a surgical procedure has been found to be 0.3%.[1] The integrity of undamaged gloves protects the surgeon from such infection transmissions and thus a practice of double gloving further reduces this significant risk. Factoring the amount of blood and viral load of the patient, the surgeon is vulnerable to risk of infection transmission upon breaching of the glove intactness.[2] Orthopaedic surgeries have always been associated with a higher rate of glove punctures due to frequent use of sharp instrumentations, power tools and also the sharp bone fragments.[3]

Thus the aim of this study to evaluate the rate and the nature of glove punctures during orthopedic surgeries and also the situations and conditions that lead to these perforations.

MATERIALS AND METHODS

This has been a prospective study conducted at our Institution from Jan 2015 to July 2015. The gloves used in the 140 orthopaedic surgeries from this hospital were evaluated from the members of the part of the operating team that included the surgeon, first and second assistant and OT technician.

The members of the surgical team were having double gloves. The surgeons are given pre sterilized gloves which were not tested before the surgery. The gloves collected from the surgeon doing routine orthopaedic surgery. The gloves that were later collected, labeled and evaluated after the surgery through a standardized water leak method (EN 455-1). Each of the gloves was inflated with 1000 mls +/- 50 mls of water at 20 degree Celsius with gentle squeezing looking for punctures. Once the punctured gloves were identified during the operative procedure, those gloves were immediately replaced with a similar glove. Unused control gloves from the same pack were also tested in the same manner after each procedure. Factors such as duration of surgery, number of members of the operating team, type of surgery, outer or inner glove, dominant or non-dominant hand and the digit perforations were considered. All these data was analyzed with Epi info version 3.5.3 where the significant level was fixed as $p<0.05$.

RESULTS

There were a total of 140 operations that were assessed for glove perforations and a total of 1856 gloves were assessed. 240 gloves were found to have punctures giving a glove perforation of 12.6. (Table 1) Gloves in 63 of the 140 operations were perforated giving a 45% operative perforation rate. (Table 2)

Table 1: Glove Perforation Rates

Team Members	Number of Members	Number of Gloves	Number of Perforations	Glove Perforate Rate
Surgeon	140	560	120	21.4
1st Assistant	140	560	34	6%
2nd Assistant	80	320	18	5.6%
Scrub Nurse	110	440	5	1.13%
Total	**470**	**1880**	**177**	**9.4%**

Table 2: Operative Perforation Rate

Team Members	Operations with Perforated Gloves	Operations without Perforated Gloves	Total
Surgeon	63 (45%)	77 (55%)	140
1st Assistant	20 (14.2%)	99 (70.7%)	140
2nd Assistant	15 (18.7%)	60 (75%)	80
Scrub Nurse	5 (4.5%)	105 (95.4%)	110
Total	**123**	**341**	**470**

Table 3: Outer and Inner Glove Perforation Rate

Team Members	Outer Gloves	Inner Gloves	Total
Surgeon	70 (71.4%)	25 (25.5%)	98
1st Assistant	25 (83.3%)	5 (16.3%)	30
2nd Assistant	15 (83.3%)	3 (16.6%)	18
Scrub Nurse	2 (66.67%)	1 (33.3%)	3
Total	**112 (75.16%)**	**34 (22.8%)**	**149**

Table 4: Perforations Related to duration of the Surgery

Team Members	< 100 minutes	>/= 100 minutes
Surgeon	20	45
1st Assistant	7	23
2nd Assistant	8	19
Scrub Nurse	3	0
Total	**38 (30.4%)**	**87 (67%)**

Table 5: Site of Glove Perforation

Finger	Surgeon's hand dominance		First Assistance		Second Assistance		OT Technician		Total
	D	ND	D	ND	D	ND	D	ND	
Thumb	8	1	8	6	5	3	1	0	32 (22%)
Index	32	38	6	3	3	1	0	0	83 (57%)
Middle	8	2	5	2	1	0	0	0	18 (12.4%)
Ring	3	1	2	1	1	0	0	1	9 (6%)
Little	1	0	1	0	0	0	0	1	3 (2%)
Total	**124**	**42**	**23**	**12**	**10**	**4**	**1**	**1**	**145**

D= Dominant Hand, ND= Non-Dominant Hand

Table 6: Rates of Perforation in Various Procedures

Surgical Procedure	Surgeon	First Assistance	Second Assistance	Total
Amputation	7	2	1	10 (5%)
Hemiarthroplasty	15	4	8	27 (13.9%)
ORIF ILN	19	10	25	54 (27.83%)
ORIF P/S	24	10	23	57 (29.3%)
THR	9	6	12	27 (13.9%)
Others	8	1	10	19 (9.7%)
Total	**82**	**33**	**79**	**194 (100%)**

The primary surgeon was the member of the operating team with the highest rate of 21.4% perforations. The OT technician had the least rate of glove perforation of 1.13% (Table 1). We found out that outer glove was perforated in 75.16% of gloves compared with the inner gloves 22.8% (Table 3). Surgical procedure lasting greater than 100 min were also related to a higher glove perforation with the rate 67% (Table 4).

The index finger 57%, the thumb 22% and the middle finger 12.4% were the most commonly punctured. The surgeon's non-dominant hand index finger had the maximum number of punctures. Open reduction and internal fixation of the fractures with interlocking nails and plates and screws had the most procedural perforation rates of 27.83% and 29.3% respectively.

DISCUSSIONS

Glove perforations are established problems in orthopaedic surgery.[3,5] Surgeons are always at risk of contacting infections from punctured wounds during a surgical procedure. The prevalence of HIV in India is 3.4% putting the surgeons at great risk compared to the surgeons in other developed countries where the prevalence of HIV is 0.3%.[1]

Undamaged gloves act as a barrier to the transmission of blood borne infections during the surgical procedure. The duration of contact of the infected blood with perforated gloves put the surgeon to an increase risk of infection transmission. This study shows a high operative rate of glove punctures 48.2% that is similar to what other investigators have found.[9,10] The above study showed a glove perforation rate of 9.4 % compared with a rate of 8.7-15% in other studies.[2,5] The high operative perforation rate in orthopaedic surgery is due to the use of sharp instrumentations such as power drills, screws, wires, saws as well as presence of sharp ends of the fractured bones. It also has been realized that the perforation rate of 32.3% and 30.7% with the open reduction and internal fixation of fractures with interlocking nails and plates and screws respectively. Surgeries with durations longer than 100 minutes have shown a glove perforation rate of 67%. Many authors have promoted the change of outer gloves following a 120 minutes surgical procedure.[9,10] During our study we found out that the glove perforation rate of 75.16% and inner glove perforation rate of 22.8% thus warranting the benefit of double gloving.

Main operating surgeon's index finger was the most punctured; with the index finger perforation rate of 57% and the thumb 22%. The OT technician had the least perforation rate in our study which is defiant to the finding by Yinusa et al[2]. The non-dominant hand has been found out to be the most frequently involved, but in our study we had the dominant hand the more frequently involved.[1,2,10] Many surgeons still prefer the use of single gloving due the tightness, clumsiness and discomfort related to the double gloving. Some studies have promoted the reinforcement of the index finger and thumb in gloves particularly for single gloving.[6,11]

CONCLUSION

The routine use of double gloving technique in orthopaedic surgeries has been warranted by our study since the orthopedic surgeries have the highest operative perforation rate. Following the double gloving we emphasize that risk of contact with the patient's blood with the added safety of an intact inner glove. We also advise and promote the change of the outer glove in surgical procedures lasting more than 100 minutes. The operating surgical team should always be careful about any signs of perforations and change the gloves immediately upon noting it. All these precautions and suggestions will help to reduce the contact with the patient's blood through perforated gloves, resulting in the reduction of the transmission of the blood borne infections during the orthopaedic surgeries.

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