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# Evaluation of Direct/Indirect Pulp Capping Procedures Requiring Root Canal Therapy

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## Abstract

The common objective of pulp capping is to induce a physical protective barrier over the pulp to maintain the vitality and function of the tooth. Indirect pulp capping is done in cases where deep carious lesions are found in tooth and lesion is adjacent to vital pulp tissues. Pulp capping remains a controversial topic as opinions on pulp capping treatment vary from clinicians, despite new advances gained through research. Many clinicians are reluctant to opt for direct pulp capping as a treatment option in cases of carious exposed pulp may be due to conflicting data and findings reported regarding success rate of pulp capping. The aim of this study was to evaluate the number of direct/indirect pulp capping cases which underwent root canal therapy. This study included adults above 18 years who had previously undergone direct/indirect pulp capping and reported to dental hospital between June 2019 to March 2020. Around 86000 patient records were reviewed and analysed for the inclusion criteria and the following parameters were extracted; (i) Patient's gender, (ii) type of pulp capping, (iii) teeth involved and (iv) teeth which underwent root canal therapy. Data was recorded in Microsoft Office Excel (2013) and analysed using SPSS Software Version 26.0. Chi-square test was done to find out correlation between variables. Significant level test was set at $p<0.05$. A total of 218 teeth were found to have undergone pulp capping, those of which were 33.9% direct pulp capped tooth and 66.1% indirect pulp capped tooth. The teeth involved were 4.1% anteriors, 9.6% premolars and 86.2% molars. 18.8% of capped teeth underwent root canal therapy. More females (21%) underwent root canal therapy than males (17.5%). A higher percentage of premolars underwent root canal therapy compared to other teeth (42.9%) and more indirect pulp capped teeth underwent root canal therapy (20.1%) than direct pulp capped teeth (16.2%). Within the limits of this study, it was observed that the number of pulp capping cases which underwent root canal therapy is about one fifth and was more commonly seen in premolars and in indirect pulp capping cases.

***Keywords:** Deep caries management, Direct pulp capping; Endodontics; Indirect pulp capping; Root canal therapy.*

## Introduction

Pulp capping is an operative procedure which attempts to maintain the tooth vitality and facilitate reparative dentin formation [1]. The common objective of pulp capping is to induce a physical protective barrier over the pulp to maintain the vitality and function of the tooth. Indirect pulp capping is done in cases where deep carious lesions are found in tooth and lesion is adjacent to vital pulp tissues [2]. Whereas direct pulp capping is a treatment option for teeth with mild cariously exposed pulp [3]. Pulp capping remains a controversial topic as opinions on pulp capping treatment vary from clinicians, despite new advances gained through research [1]. Many clinicians are reluctant to opt for direct pulp capping as a treatment option in cases of carious exposed pulp

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may be due to conflicting data and findings reported regarding success rate of pulp capping (approximately 37%-100%) [4–6]. Moreover, the tooth can develop into irreversible pulpitis and patients may experience pain and will have to go for root canal therapy [7]. Despite the issues faced in pulp capping treatment, it remains as a minimally invasive procedure that saves cost, time and effort compared to pulpectomy or pulpotomy. It can be said that such treatment options are valid from a socioeconomic point of view [8]. Many previous authors have attempted to find out prognostic factors which can influence the outcome of treatment to increase the success rate of pulp capping [4,9,10]. On the other hand, some failures may be due to previous impaired condition of the pulp rather than other factors, especially in cases of failure that occur soon after pulp capping treatment [11]. Despite pulp capping treatment being a controversial topic, some studies reported direct pulp capping to be the appropriate treatment option for carious as well as traumatic or mechanically exposed pulp [9,12].

Previous study reported the prognosis of pulp capping vary in success rate, ranging from 13-100% [1]. Paul et al. reported that the prognosis of direct pulp capping can be unpredictable and has the lowest success rate in caries exposed pulp in adult dentition [1]. Baume et al. Studied the long term clinical assessment of direct pulp capping and stated that there is an increased risk of failure if pulp is diseased before capping [13]. The same study also reported pulp capping performed by skilled practitioners have a higher success rate (90%) than compared to treatment done by students (80%) [13]. Higher risk of pulp capping failure may also be due to cases with preoperative toothache [14].

Over the past 5 years, innumerable clinical trials [15–20], in-vitro studies [21–26] and article reviews [27–29] had previously been conducted by our team. Currently we are focusing on analysing the need for root canal treatment in pulp capped teeth. The aim of this study was to evaluate the number of direct/indirect pulp capping cases which underwent root canal therapy.

## Materials and Methods

This retrospective study involved adults of 18 years and above, both males and females, who have reported to dental hospital between June 2019 to March 2020. The study was conducted as a university-based study. This allows flexible data retrieval, automated data collection and saves cost. However, such setting only allows a limited population to be covered and study may be subjected to researcher's personal bias. Data retrieval was approved by the Ethical Committee Board of dental hospital and will be covered by the following ethical approval number. SDC/SIHEC/2020/DIASDATA/0619-0320. Patient's informed consent was obtained prior to clinical examination of the patients.

Around 86000 patient records between June 2019 to March 2020 were reviewed and analysed for tooth treated with direct or indirect pulp capping and the cases were cross-verified with radiographs and intraoral photographs uploaded into the system. Data was collected by a single calibrated examiner. The inclusion criteria included patient's above 18 years and patients who had undergone direct/indirect pulp capping. Patients below 18 years, medically compromised patients and patients without pulp capping were excluded from the study. The following parameters were observed and recorded: patient's gender, type of pulp capping, tooth involved and pulp capped tooth which underwent root canal therapy

### Statistical Analysis

All the data obtained were entered into Microsoft Office Excel (2013) and analysed using SPSS Software Version 26.0. Descriptive statistics were used to report distribution of gender, type of indirect pulp capping, tooth involved and pulp capped tooth which underwent root canal therapy. Chi-square test was conducted to find correlation in variable factors such as gender, type of pulp capping, tooth involved and tooth which underwent root canal therapy. Significance test level was set at $p<0.05$.

## Results and Discussion

A total of 218 teeth were found to have undergone pulp capping. Out of which 81 were females and 137 were males. 33.9% of those teeth were direct pulp capped teeth and 66.1% were indirect pulp capped teeth (Figure 1). As for the tooth involved, 4.1% were anterior teeth, 9.6% premolars and 86.2% molars (Figure 2). Out of 218 pulp capped teeth, 41 teeth (18.8%) underwent root canal therapy and the remaining 177 teeth (81.2%) did not undergo root canal therapy (Figure 3).

Based on gender, more females (21%) had undergone root canal therapy than compared to males (17.5%)(Figure 4). No correlation in tooth underwent root canal therapy was found between genders ($p>0.05$)

(Figure 4). More pulp capped premolar teeth (42.9%) underwent root canal therapy compared to anteriors (33.3%) and molars (15.4%) and pulp capped teeth in molars which did not undergo root canal therapy were higher compared to other teeth (Figure 5). Statistically significant association was found between teeth which underwent root canal therapy and the teeth involved ($p<0.05$) (Figure 5). More indirect pulp capped teeth underwent root canal therapy (20.1%) than direct pulped teeth (16.2%) and both direct and indirect pulp capped teeth which did not undergo root canal therapy were higher when compared to those which underwent root canal therapy (Figure 6). However, no significant association was found between teeth which underwent root canal therapy and type of pulp capping ($p>0.05$) (Figure 6).

Pulp capping is generally considered not applicable to pulp exposed by caries due to high risk of such pulp being contaminated [7,30]. However, a previous study reported that teeth with mild carious exposed pulp as well as traumatic or mechanical pulp exposure should be treated appropriately with direct pulp capping [9,12]. Despite controversial issues related to pulp capping, the treatment should not be completely contraindicated. Moreover, high success rate of pulp capping treatment should not be expected even with appropriate cases as outcome can be unpredictable.

Our study found that the overall success rate of pulp capped teeth was 81.2%. The remaining 18.8% of pulp capping cases failed and underwent root canal treatment. Similar findings were reported by Matsuo et al. and Baume et al.[9,13]. Matsuo et al. reported the success rate of pulp capping to be 81.2% [9]. Baume et al. reported a similar finding of 80% success rate in pulp capping performed by students [13]. Al-Hiyasat et al. contradicted the finding of the current study and reported a lower rate of success of pulp capping (59.31%) [31].

Our study reported more number of pulp capping cases in females compared to males but this finding was not statistically significant ($p>0.05$). A study by Al-Hiyasat was in agreement with our study. He reported that the patient's gender had no significant effect on the outcome of treatment ($p>0.05$) [31]. This adds to the overall consensus and is to be included in clinical practice.

Based on our research, 16.2% of direct pulp capping and 20.1% of indirect pulp capping had failed and underwent root canal therapy. In a previous study, the reported rate of failure of direct pulp capped tooth was 18.2% which was almost similar to our current finding [9]. However, some studies were in disagreement with our current finding, reporting a lower rate of failure of indirect pulp capping [32,33]. The difference may be due to variation in type of pulp capping material, restoration and adequacy of caries removal.

The current study was conducted to find out the number of pulp capping cases which underwent root canal therapy. Many factors play a role in the success of pulp capping such as adequacy of caries removal, state of pulp, type of restoration and interval of follow-up. The data on such information were limited and therefore were not included in our study. Extensive research needs to be done to include a large sample population. Further studies can be done with inclusion of other factors which may contribute to the success rate of pulp capping treatment.

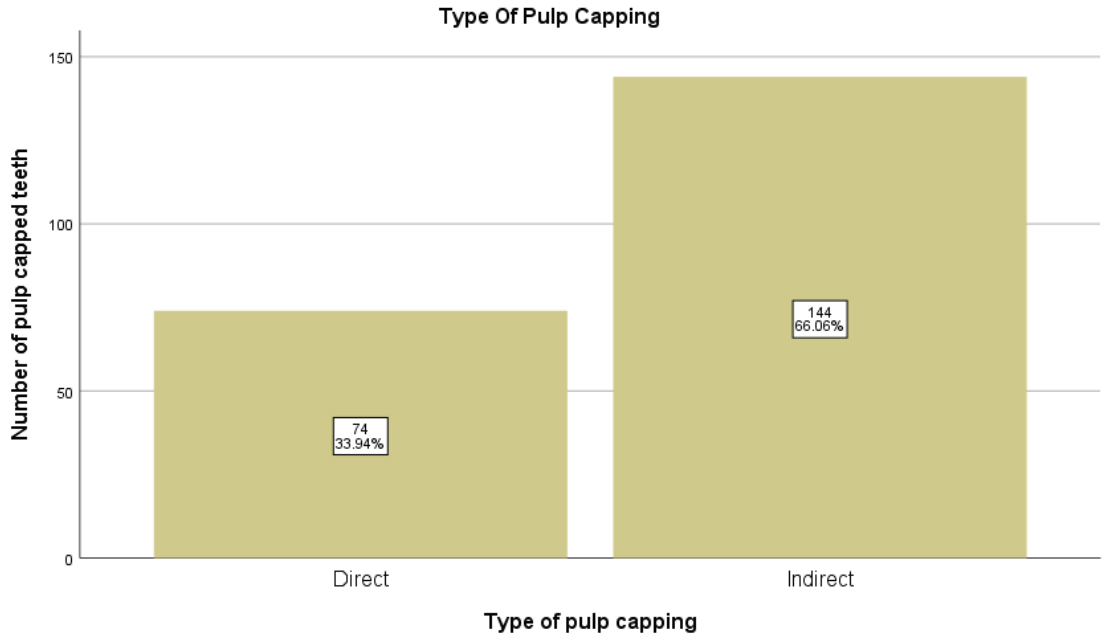


**Figure 1. Bar chart depicts the number of pulp capped teeth by type of pulp capping. X-axis represents the type of pulp capping and Y-axis represents the number of pulp capped teeth. Patients presented with indirect pulp capped teeth were more compared to direct pulp capped teeth.**

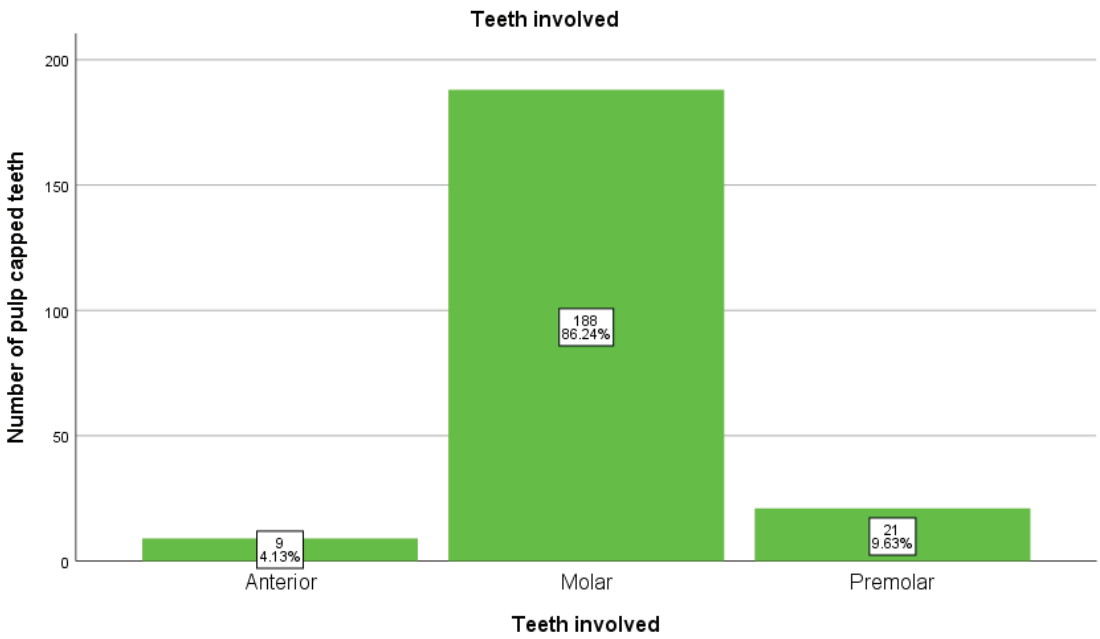


**Figure 2. Bar chart depicts the distribution of pulp capped teeth by teeth involved. X-axis represents teeth involved and Y-axis represents the number of pulp capped teeth. Number of pulp capped teeth were more in molars compared to other teeth involved.**

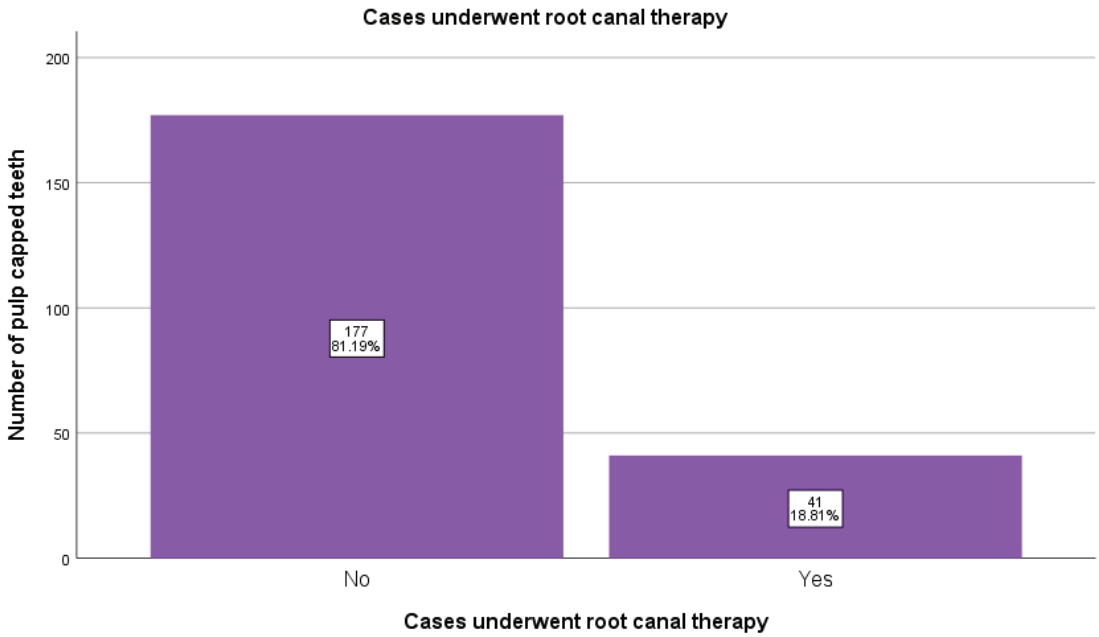


**Figure 3. Bar chart depicts the number of pulp capped teeth and cases which underwent root canal therapy. X-axis represents cases which underwent root canal therapy and Y-axis represents the number of pulp capped teeth. Pulp capped teeth which underwent root canal therapy were comparatively less in number.**

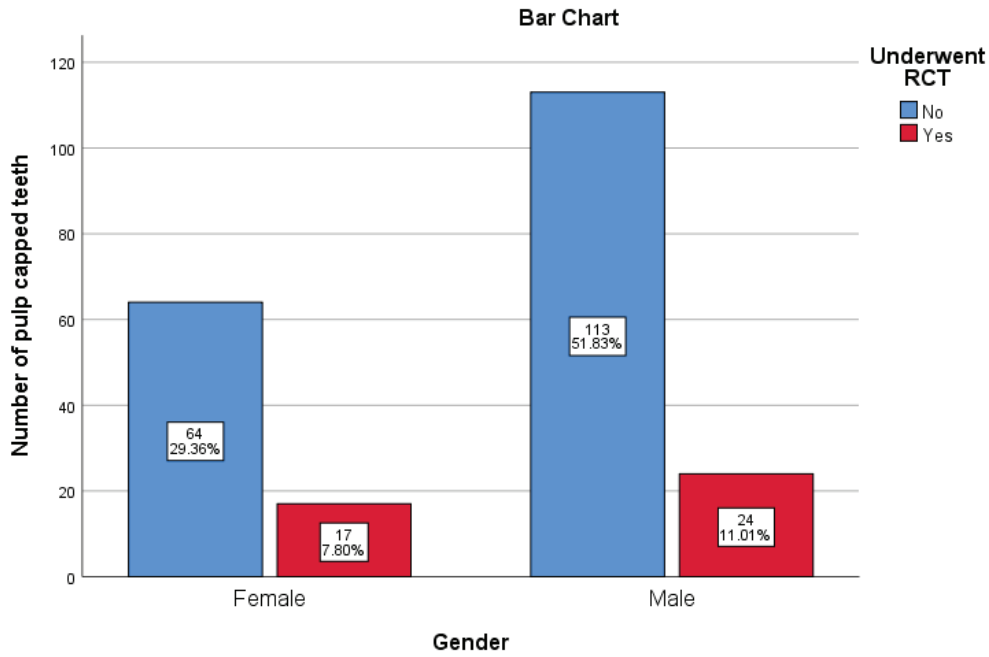


**Figure 4. Bar chart depicts the association between pulp capped teeth which underwent root canal therapy and gender. X-axis represents the gender and Y-axis represents the number of pulp capped teeth which underwent (yes- red) and did not undergo (no- blue) root canal therapy. Pearson chi-square value- 0.401 , p value- 0.526 (p>0.05), hence, not significant. More males with pulp capped teeth that did not undergo root canal therapy were seen compared to females but the results were statistically not significant.**

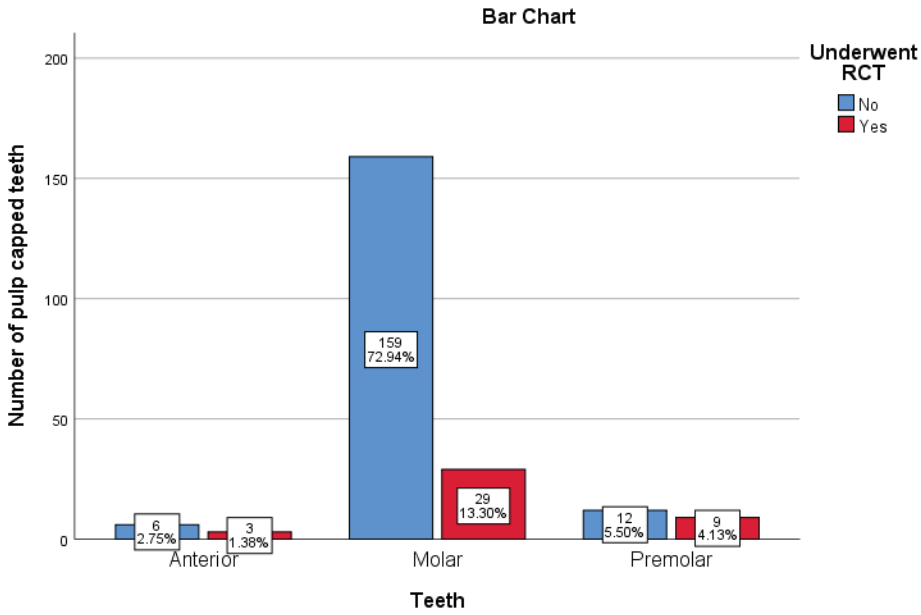


**Figure 5. Bar chart depicts the association between pulp capped teeth which underwent root canal therapy and teeth involved. X-axis represents the teeth involved and Y-axis represents the number of pulp capped teeth which underwent (yes- red) and did not undergo (no- blue) root canal therapy. Pearson chi-square value- 10.606 , p value- 0.005 (p<0.05), hence, statistically significant. Pulp capped teeth (molar) which did not undergo root canal therapy were significantly higher compared to others and the results were statistically significant.**

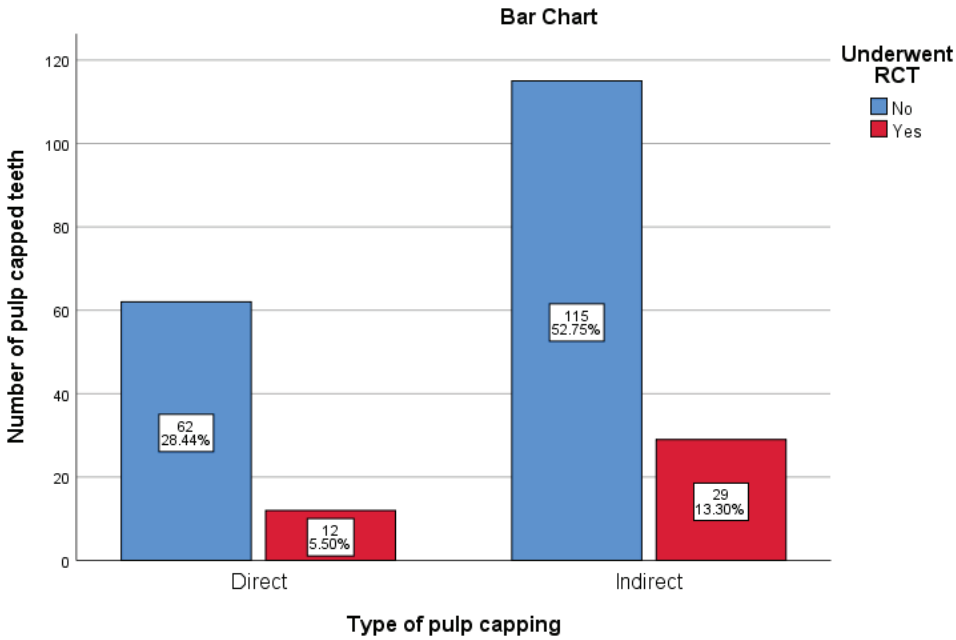


**Figure 6. Bar chart depicts the association between pulp capped teeth which underwent root canal therapy and type of pulp capping. X-axis represents the type of pulp capping and Y-axis represents the number of pulp capped teeth which underwent (yes- red) and did not undergo (no- blue) root canal therapy. Pearson chi-square value- 0.493, p value- 0.483 (p>0.05), hence, not significant. Pulp capped teeth (direct/indirect) which did not undergo root canal therapy were higher when compared to those which underwent root canal therapy but the results were statistically not significant.**

## Conclusion

Within the limits of this study, it was observed that the number of pulp capping cases which underwent root canal therapy was about fifth of the total cases, and was more commonly seen in premolars and in indirect pulp capping cases.

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**Conflict of Interest :** No conflict of interest has been declared by the authors.

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**Ethical Clearance:** It is taken from "Saveetha Institute Human Ethical Committee" (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320)

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